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A

TREATISE

ON

ARTILLERY:

TO WHICH IS ADDED,

A SUMMARY OF MILITARY RECONNOITRING,
OF FORTIFICATION,
OF THE ATTACK AND DEFENCE OF PLACES,
AND OF CASTRAMETATION.

BY H. LALLEMAND,
General of the Artillery of the late Imperial Guard of France.

TRANSLATED FROM THE MANUSCRIPT OF THE AUTHOR,
BY JAMES RENWICK.

VOL. I.

NEW-YORK:
PRINTED BY C. S. VAN WINKLE,
No. 101 Greenwich-street.
1820.

Southern District of New-York, ss:

BE IT REMEMBERED, that on the first day of August, in the forty-fifth year of the Independence of the United States of America, H. LALLEMAND, of the said district, hath deposited in this office the title of a book, the right whereof he claims as proprietor, in the words and figures following, to wit:

"A Treatise on Artillery: to which are added, a summary of military reconnoitring, of fortification, of the attack and defence of places, and of castrametation. By H. Lallemand, General of the Artillery of the late Imperial Guard of France. Translated from the manuscript of the author, by James Renwick."

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ADVERTISEMENT.

It *is not without a sensation of diffidence, that the Translator submits the following work to the eye of the Public. His previous pursuits have been so far removed from the profession, either of the Soldier or the Author, that he could hardly flatter himself with any brilliant success in his new employment.*

The object he has kept steadily in view throughout his labours, has been to give, to the American Military Reader, a plain and intelligible version of his author. In order to accomplish this, he has not scrupled to avail himself of several words and modes of expression that have lately become familiar in our army. Among these, he must particularize the use he has made of the words Material, Personal, *and* Arm; *without the introduction of which, his author, and, indeed, no French military work of the present day, could be correctly rendered. The military terms of the English language have, for the most part, been borrowed from the French by a series of successive authors, and the translator has done no more than add a few to the number.*

The Chapters that contain the manœuvres were translated by that distinguished officer, Colonel Fenwick, and printed before the present translator undertook the work; it is needless to say, that they are much more valuable on that account.

A few pages of a former translation have been retained in the Nomenclature, and the beginning of the article on the Construc-

tion of Batteries; for the sake of uniformity, the terms therein employed have been used in one or two other places.

To General Swift, who first pointed him out as fitted to undertake the work, the Translator is under many and weighty obligations; he has also received information upon one particular head from Major Thayer; but from neither of them any assistance of such a nature as to render them at all responsible for the manner in which he has executed his task.

New-York, August, 1820.

INTRODUCTION.

The works upon Artillery, that have been published up to the present time, may be divided into two classes: one of these treats of isolated parts of the art; the other consists in artificial memories, more or less complete. In the first class may be ranked the writings of *Antoni*, *Belidor*, *Blondel*, *Dumouy*, *Dupuget*, *Frezier*, *Gaya*, *Hutton*, *Leblond*, *Lespinasse*, *Lombard*, *Monge*, *Montalembert*, *Morlat*, *Robins*, *St. Remi*, *Scheel*, *Struensee*, *Tartaglia*, *Tempelhof*, *Vauban*; in the second, the dictionary of *Bohm*, those of *Eggers* and *Lachenaye*, and the works of *Durtubie* and *Gassendi*.* The perusal of the first is necessary for those persons who, either from profession or taste, devote their time to the study of Artillery; the others are only fitted for such as have previously acquired a knowledge of the art, and have need of them merely to assist their recollection.

As the above list contains the names of all authors on Artillery of established reputation, it may be seen that there does not exist any treatise, which completely embraces all the branches of that art; Material, Personal, and applicable in war. The reason of this, as regards Europe, is, that the service of the Artillery there is entirely confided to regular troops, while the militia has neither the Personal nor the Material of this arm; it is, in consequence, less useful to disseminate among the citizens a complete system of theo-

* I regret that I cannot cite among these authors the celebrated General Gribeauval, the greatest part of whose manuscripts are lost to the world. France owes to him the organization of a system of Artillery, that has every where sustained the just reputation of the illustrious author.

retic and practical information on this subject. The officers of the Artillery of the line are, in all European nations, instructed both in the theory and practice of their art, in schools established for that express purpose: their gradual promotion, their successive round of service in their regiments, in fortresses, arsenals, founderies, forges, and manufactories of arms, enable them, after leaving the Artillery school, to render themselves master of every branch of their profession. Besides, in all these establishments they meet with manuscripts, models, and documents, containing information of great value.

But if a treatise that embraces all the branches of the art, is not absolutely essential in Europe, it is so in a nation like the United States, where all the citizens are, without distinction, called to the service of their country, that not only calculates on the devotedness and courage of which the American militia have given such brilliant examples, but expects from them a knowledge of the theory and practice of those arts that constitute the modern system of war. It is also necessary in a country where the corps of Artillery does not yet possess the same opportunities of instruction that exist in the principal states of Europe.

In this treatise will be contained every thing that relates to the *Personal* and the *Material* of Artillery, viz: The principles of organization; the theory of, and tables for firing; the Nomenclature, and exercise of Field, Battering, Garrison and Sea-coast pieces; the school of Field-pieces, and Mountain-guns; the manœuvres and evolutions of field batteries; Mechanical manœuvres; the construction of Batteries and of Military Bridges; the proportion of cannon of different sorts that should be attached to an army, and their division among the different corps; the service of Artillery in the field; its position and service in battle, as well as in the attack and defence of field works; the composition of a Field Artillery equipage, and the load of its several carriages. Such are the articles that compose the first part of this undertaking.

The second part is devoted to points of information, that, although merely accessory, are not less useful to artillery

officers during a campaign: among these are Military Reconnoitring; Field Fortification; the Principles of Permanent Fortification; the Conduct of a Siege, as regards both the Attack and Defence of Fortresses; the Composition of an Equipage of Siege Artillery; an Estimate of the Stores required for the Supply of Garrisons, such as Cannon, Ammunition, Provisions, &c.; the Preparation of Ammunition and Military Fire-works; and Castrametation.

A third part is still wanting to complete the work; this will comprise an account of the chief dimensions of, and the mode of constructing and manufacturing, cannon, gun and other carriages, small arms, projectiles, gunpowder, &c.; notices of the principal raw materials, that are employed, such as iron, steel, copper, wood, &c.; in short, the organization and routine of the duty of Arsenals and all Artillery establishments. This part is completed; but I do not wish to put it to press, until the two first shall have received the sanction of public approbation.

The utility of Artillery is too well understood, at the present day, to require me to answer the sophisms that have often been urged against it. I shall content myself with comparing two armies together; one of which is provided with artillery, and the other not. This comparison resolves the question in the only relevant manner; for whether two armies, both without artillery, can fight or not, is not the question here.

In what way can an intrenchment furnished with artillery be attacked by troops that have none? How can a modern fortress be approached, or its walls breached, without cannon? How can a corps manœuvre in the open field, under the fire of an enemy's artillery, or compel him to attack with caution, if it have no pieces to contend with his, to cut up the ranks of his infantry, and prevent him from displaying and forming? How can the passage of a river be effected in the presence of an enemy, without artillery to clear the opposite bank, so as to allow the troops to take a position upon it, that cannot be forced? How can a defile be defended with-

out artillery, against an enemy that is provided with it? How can an enemy be long resisted, by a fortress without artillery? How, without formidable batteries, can we arrest the progress of those floating citadels that would approach maritime cities, marine *depots*, the warehouses of the state and of individuals, for the purpose of destroying them? All actions in war, although not impossible without cannon, are, at least, very difficult, hazardous, and bloody; and all the chances of success are in favour of him that is provided with artillery.

It is not, then, the question of the utility of Artillery that is now to be discussed, but the principles that ought to govern the organization of the Personal and Material of this arm, the mode of instructing and manner of employing it in the different circumstances of a war. I shall, in the course of the work, have occasion to treat of the most important of these principles, some of which are not yet sufficiently disseminated; and shall, therefore, in this place, content myself with submitting to the public some concluding observations, that are of a nature not uninteresting, even to those who are not particularly devoted to the Artillery service.

For nearly three centuries, Artillery has been the subject of much study in Europe. Well informed officers, men eminent in the exact sciences, others equally celebrated in the mechanic arts, and above all, distinguished generals, have contributed with zeal to the progress and advancement of an art, upon which the fate of battles in some measure depends; in fine, wars of long duration, and abounding in varied actions performed upon sites differing from each other in topographical character, have pointed out what was good, and have shown such things as were defective. It may then be imagined that innumerable inventions have been made and rejected; that an infinity of innovations, ingenious and seducing at the first view, have either failed upon close examination, or have been thrown aside, after receiving a condemnation on account of their unfitness for service in war. The arsenals of Paris and Vienna alone, are crowded with contrivances, all curious in their way, but offering models that

do more credit to the imagination, than to the judgment of their authors. Among a thousand inventions or fancied improvements, it is difficult to find a single one that has not been already made and condemned; and even if it be new, it cannot be admitted into a system, until it has been submitted to practice during the course of a war.* An expert artillerist, then, will not waste his time on those trifles that are rather ingenious than useful, but will employ himself in searching for those great results, that flow from a judicious consideration of the effects of his arm.

Far be it from me to wish to arrest the progress of an art in which, beyond doubt, there remains much yet to be done. The inventive genius, so natural to the soil of the United States, will probably contribute in a great degree to the discovery of the desired improvements; I have, then, no other object than to guard against the torrents of trifling alterations, that, without any real utility in service, will have the effect of destroying the system of uniformity, and of involving the state in costly experiments; nay, may often commit its safety at the very moment of action. In this art the invention that is absolutely the best possible, may not be, relatively speaking, a good one; mankind cannot expect to attain perfection, and should, therefore, listen to the dictates of prudence; these demonstrate, that in many cases it is unnecessary to do more than make a judicious choice among subsisting inventions, and to employ, in the best way, such things as practice and experience have proved to possess, at once, as many excellencies and as few inconveniences as can readily be combined.

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* Thus, Congreve rockets have been found totally insignificant at Boulogne, Flushing, and in other actions where they have been used.

CONTENTS OF THE FIRST VOLUME.

Principles of the Organization of the Material and Personal; Theory of, and Tables for, Firing; a Nomenclature; the Exercise of Field, Battering, Garrison, and Sea-coast Pieces; the School of Field and Mountain Guns; the Manœuvres and Evolutions of Field Batteries; Mechanical Manœuvres; the Construction of Batteries, and of Military Bridges; the Proportion of Cannon of different sorts that ought to be attached to an Army, and their distribution; the Service of Artillery in the Field; its Position and Service in Battles, and in the Attack and Defence of Field Works; the Composition of the Equipage of Field Artillery; the mode of loading Caissons, Forges, Waggons, &c. and of embarking Artillery.

A

TREATISE

ON

ARTILLERY.

Artillery is the art of constructing, preserving, and using, all the machines that are employed in war.

In the two first parts of this treatise, we shall consider it in relation to the last part of this definition only; it is not, however, the less necessary, to give a general idea of what these machines are.

OF THE MATERIAL OF ARTILLERY.

OF CANNON.

There are three species of Cannon, the *Gun*, the *Howitzer*, and the *Mortar*.

The Gun is the longest piece of artillery employed at the present day; its use is to throw round balls. (Pl. 5. fig. 1.) There were formerly guns, with bores twice, and even three times as long as those now used; they were named *culverins*, *dragons*, &c.*

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* The culverin of Genoa, a 36 pounder, had a bore 58 calibers in length; and one taken by the French at Erhenbrestein, weighed 11 tons.

The invention of guns dates from the year 1336, or thereabouts; they were then called bombards, and were eight calibers in length; they were also called *pierriers*, from *pierre*, a stone, because the balls were made of stone, and even rough stones were thrown from them. When they carried 120 lbs. of stones, they were 13 inches (French) in diameter, the charge was 29 pounds of pow-

There is a sort of short gun called a *carronade*, with a bore about eight diameters of the shot in length. Its caliber is usually that of a 32 or 42 pounder. Carronades do not carry as far as long guns, and are only used in the naval service.

The Howitzer is a species of mortar, but is longer than it. Its form is that of a short gun, (pl. 5. fig. 5.) and it is manœuvred in the same way. It serves to throw a hollow projectile, called a howitz, which acts at first as a *ricochet* ball, and afterwards bursts like a shell. This projectile proceeds bounding along the ground, buries itself in mounds of earth, destroys or tears them down; sets fire to houses; penetrates into hollows a cannon ball cannot reach; produces a more lasting terror than it does, because its effects do not cease with its flight, and are not at an end until it has burst into destructive fragments. It is a most formidable weapon, and ought to be extensively employed in war. The howitzer is borrowed from the Dutch, who invented it in the 17th century, and called it *haubitz*.

A Mortar is the shortest species of cannon. It is used to throw hollow projectiles, filled with gun-powder, that are called shells or bombs; these break into vaults, set fire to buildings, and burst in deadly splinters. This weapon is principally used in the attack and defence of places, for which it is particularly calculated by the curved trajectory of its projectile. (Fig. 3. and section, fig. 2.) Mortars take their date from the siege of Rhodes in 1522.

The Stone Mortar differs from the Mortar in not being so much charged with metal. (Fig. 4. pl. 5.) It is used in sieges, to throw stones upon an enemy who is close at hand.

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der, or 40 pounds if it threw a ball. They carried their projectile 1500 paces. Cannon, at first, were only used in the defence of places.

A French historian speaks of a cannon made at Tours, in the year 1470, whose stone ball weighed 500 lbs. (the caliber being 21 inches,) and was thrown 5700 yards. It is also said, that the Turks, had cannon that carried balls of 1200 lbs. at the siege of Constantinople. (*Aide Memoire à l'usage des officers d'artillerie de France*, by General Gassendi.)

Of the Bore and the Chamber.

The bore of a piece of ordnance is the interior cavity. The chamber is the part occupied by the charge of powder; in the gun it is merely a continuation of the bore, rounded at the bottom; in howitzers, mortars, and stone mortars, it has a different form from, and is narrower than, the bore. These different shapes may be seen in the figures of plate 5. Chambers of the shape of an inverted truncated cone, are now acknowledged to be the best for mortars; this chamber being a continuation of the bore of the piece, the shell touches its sides exactly, (pl. 5. fig. 2.) and leaves no passage by which the elastic fluid, produced by the inflammation of the powder, can escape without acting on the projectile; its whole force, then, acts upon the shell, and there is no longer any windage to make it strike against the bore of the mortar. (See the head of *Firing.*) Many howitzers have this sort of chamber; as have also the Piedmontese mountain three pounders, and some English four pounders, (navy guns I believe,) that produce, or have the credit of producing, long ranges.

Some authors have asserted, that a spherical figure is the best for the chambers of mortars, because it resembles that in which the inflamed powder would naturally act. This form appears to me the least advantageous of all, because the chamber that narrows as it approaches the bore, resists a part of the action of the powder, and causes it to react upon the bottom of the piece, thus augmenting the recoil without increasing the impetus. General Gassendi proposes to form the sides of this chamber, by tangents, common to the shell and the chamber.

Of the Touch-hole or Vent.

It is agreed upon all sides, that the vent of a piece of artillery would be most advantageously placed if it communicated the fire to the centre of the charge; for, in this case, the inflammation of the powder, which is not instantaneous, but successive, takes place soonest. However, it is usually made to enter the bottom of the charge, to avoid too violent a recoil, that would derange the fire, and injure the gun carriages; particularly those of large caliber.

Of the Caliber and the Length of the Bore.

By caliber, is understood the diameter of the bore of pieces of cannon ; the caliber of a gun is always distinguished by the weight of its ball ; those of the howitzer or mortar, are usually known by the diameter of their bores in inches ; it would, however, be better to name them from the weight of their howitz or shell, for that would give a better idea of the power of these fire arms.

The proper length for the bore of guns has never yet been settled. Some have been made of the enormous length of 26 calibers.* In France, those intended for field service are reduced to the length of 17 calibers, and mountain pieces to that of 11. The length of 20 calibers has been preserved in 24 pounders, and that of 22 and 24 in smaller pieces, intended for the service of garrisons and sieges ; such a length is necessary, to prevent them from destroying the cheeks of their embrasures too rapidly. In Austria the field pieces are only 16 calibers in length, in Prussia no more than 14.

In order to decide this point, it is to be observed, that the experiments made in France upon pieces 26 calibers in length, that were gradually reduced to 17, shewed, that, under angles of not more than six, or less than three degrees, the ranges differed but little. But in the field, guns are seldom elevated higher than the last of these, which gives a range of 1200 yards. Besides, the ranges increase only in the proportion of the fifth roots of the length of the piece, so that by doubling the length of bore, the range is only augmented one seventh.

From this, it may be concluded, that the length of guns ought to be proportioned to the object that is in view, which may be either to make them easy to manœuvre, or to place them on a footing with other arms, and enable them to fulfil the service that is expected from them in the field.

I should consider 14 calibers as the minimum, and 17 as the maximum, of the length of the bore of field guns ; with the ex-

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* In this country, the length of guns is reckoned in diameters of the bore of the piece, and not in calibers of the shot. In mortars, the diameter of the bore is the almost universal measure.

ception of such as are to serve among steep mountains, that need not be more than 11 calibers in length, as we shall see hereafter.

The length should be as little less than 17 calibers as possible, because the aim becomes uncertain, in proportion as the length of the piece diminishes ; for example, if the visual ray passing through the middle of the breach, varies one line from the true direction, at the muzzle of a long piece, and the same quantity at the muzzle of a short one, it is clear that the shot of the first will deviate less from the object, than the shot of the second. The superiority of the French artillery, over that of the other powers of Europe, is probably in part due to their cannon being of the most suitable length ; and experience ought to guide us in this as well as in most other cases.

As regards Garrison, Coast, and Battering pieces, they may without any inconvenience be made longer, either to augment the range, or preserve the embrasures.

The practice is more uniform in regard to the length of mortars, which are generally a caliber and a half; however, it is proposed to shorten them, and thus make their aim more certain, and render them more durable. Whatever precaution is taken, in loading a mortar, to place the shell exactly in the axis, its weight naturally draws it towards the lower side of the mortar, and the windage is always less below than above ; on this account, the elastic fluid, produced by the inflammation of the gunpowder, passing in greater quantity over the projectile than under it, drives it against the upper angle of the muzzle ; this produces errors in the fire, and when the shock is very violent, breaks the shell into pieces. The shorter the mortar, the less will be the risk of these blows.

The proper length for the bore of howitzers is not yet settled ; it varies from 3 to 5 calibers. A howitz may, in many cases, do more injury than a ball ; it may be thrown into hollows, and over obstacles, where a ball cannot reach ; to give it these advantages in the fullest manner, its range should be long, without however lengthening the bore so as to cause difficulty in charging it, or to render it heavier than the field 6 pounder, with which it moves. A howitz, of the caliber of a 24 pound ball, produces effects sufficient for any purpose in the field, and is one third lighter than

the 6 inch howitz; this renders its stores much more easy to transport.

The howitzer is a valuable weapon, particularly when it has a long range. Some military men pretend that those with a range of 2,400 yards are of no real value, that when fired at objects so far distant, the ammunition is thrown away, and that this advantage, if any, may safely be abandoned to an enemy; but I am not of this opinion; with long range howitzers, the rear of an army drawn up in order of battle, the reserve, that is usually 1000 yards distant, the communications with the parks, defiles, &c., may be disturbed; and the arrival of ammunition retarded, or totally prevented.

OF THE CALIBERS THAT ARE NECESSARY.

More than 12 different calibers are reckoned in the artillery of some of the powers of Europe, besides mortars and howitzers. This is certainly too much; they ought rather to be rendered as few as possible, in order to simplify the preparation of their stores and ammunition, and because no one good purpose is answered by multiplying them. Before we proceed farther, it must be premised, that field artillery should be light, easy to manœuvre, calculated to follow the other arms in their movements, and yet adequate to destroy the obstacles that commonly present themselves.

Calibers of two kinds are needed: 1st. For the Field Service.

2d. For the defence of coasts, the attack and defence of places.

For the Field Service.

Guns of three different calibers, and one kind of howitzer, are required.

1st. A caliber to carry on a war among steep and craggy mountains; it will also serve to follow light corps in level countries. (These corps are a few companies or battalions detached to march rapidly upon some particular point; in their expeditions, cannon are almost always necessary, to break down palisades, force open gates, to astonish and intimidate an enemy; and yet either a very light piece must be employed, or none at all.) Guns for such pur-

poses, must be of a weight that will permit them to be carried upon the back of a mule; this is the first condition: they must, besides, have the longest possible range, and the heaviest projectile consistent with it. A short three pounder, 11 calibers in length, fulfils these conditions; for it must not weigh more than 190 pounds, or a mule could not carry it; a four pounder of this weight would be too short, a 2 pounder would not answer many of the purposes, and if no longer than the 3 pounder, its lightness would be of no advantage. For if a piece of 190 pounds weight can be carried readily by a mule, or transported, in case of need, by the labour of men, any diminution of its weight is a useless alteration, at the expense of its range, or the power of its projectile.

I am not of the opinion of some military men, who think that a rampart gun, or a harquebuss, is preferable, in a war among mountains, where the ordinary calibers cannot be used, to a short 3 pounder. The bullet of that fire arm is not heavy enough to batter houses, destroy palisades or enclosures, break gun carriages, or blow up caissons; besides, its range is not so great as that of a 3 pounder, it cannot fire grape shot, and produces much less effect upon the mind of the soldier.

A howitzer, of the caliber of a 24 pounder, but shorter and less reinforced with metal than the field howitzer, may also be useful in mountain warfare.

2d. A caliber is needed for those countries where carriages of an ordinary weight can travel, light enough to follow the motion of troops, powerful enough to destroy transient obstacles, and troops at considerable distances. The 6 pounder fulfils these conditions; it is not much more cumbrous than the 4 pounder, and does more execution; it weighs a great deal less than a 9 pounder, and its range is nearly as great; its manœuvre is much easier, and the gun remains always in the battle trunnion plates. A heavier caliber would not answer as well for rapidity of movement, and a lighter would be inferior in its effect.

3d. A third caliber is required to reach a distant enemy, either for the purpose of annoying him from heights, that he does not approach so near as to be within the reach of the other caliber; or of keeping him at a distance from some particular point of a line of battle; to destroy more powerful obstacles, and produce a more

determinate effect on the minds of the soldiers. The 12 pounder fulfils these conditions, and is at the same time light enough to be easily transported; it cannot, to be sure, follow the battalions in all their movements, but it may accompany the mass of the army, and march in its train in batteries of reserve. The 18 pounder is too cumbrous, and its great power would be thrown away upon men and transient obstacles; the 9 has not a sufficient superiority over the 6 pounder.

4th. A howitzer is wanted; that with a caliber of the same dimensions as the 24 pounder meets all the necessary conditions.

Note. A long three pounder, with a bore of the same relative length as other field pieces, should also be provided for light troops, and especially for militia battalions: it is a light gun, easy to manœuvre, and excellent for such purposes.

Such are the calibers that are needed in the field, and such the purposes they are intended to answer; intermediate calibers are of no use.

In the construction of Field Pieces, a metal must be employed, whose tenacity and hardness will permit their being made as thin, and consequently as light, as possible; this is more especially required in the case of the mountain piece, whose weight is limited to a certain quantity, and whose thickness cannot be augmented, without diminishing either the length or the diameter of the bore.

For the Defence of Coasts, the Attack and Defence of Fortresses,

Thirty-six pounders, 24 and 18 pounders, and long 12's and 6's, are wanted; the field howitzer may suffice; in addition there must be two species of mortars, one that will throw shells of sufficient weight to pierce buildings, penetrate magazines, and that will be still more effectual against shipping; it must have a great range, to fulfil these objects, when they cannot be reached from the ordinary distance. The long range mortar, whose shell weighs 150 pounds, is sufficient; nay, it is pretended that the 10 inch mortar, whose shell weighs no more than 100 pounds, will fulfil these conditions, as well as the larger one. This can hardly be true; but if it were well attested by experiment, a mortar of that caliber would be preferable, because more easily transported, and less

costly. There must then be another mortar, more manageable, and more easy of transport, calculated for service, in which a less powerful agent is needed; to wound men by its fragments, tear down batteries, set fire to houses, &c. The 8 inch mortar, whose shell weighs about 50 pounds, will do this, when it can be brought near enough. A 12 inch mortar of ordinary range is also needed; it weighs much less, and is, in consequence, much more portable than the long range mortar; its shell weighs the same, say 150 pounds; it will, therefore, answer as well as the other, in most circumstances: these two 12 inch mortars differ from each other only in the capacity of their several chambers, and the thickness of metal that is proportioned to the greater or less intensity of the charge. Mortars and their beds are sometimes cast in one piece; but they are subject to this great inconvenience: their charge must be altered for every different distance, which is often very troublesome; they also form a mass extremely difficult to move. (A long range mortar of this description weighs nearly 10,000 pounds.)

A little mortar weighing about 200 pounds, that will throw the 24 pound howitz, as a ball, will be very useful in the defence of places; being very manageable, and easily transported in every direction. (See vol. 2.)

The only use of the stone-mortar is to throw stones to a distance of about 160 yards; it is, therefore, evident that one sort is sufficient.

Some military men think, that a howitzer, of greater caliber than the 24 pounder, is necessary in the attack and defence of places; if this were true, the 6 inch howitzer they propose would not answer the purpose; it does not differ sufficiently from the other, to produce a much greater effect as a small mine, when fired into parapets; for this purpose, a howitzer with a caliber of at least 8 inches would be required; such a one would shake earthen works violently, and do much more damage; nor would it require the establishment of a difference in caliber of less than half an inch. An 8 inch howitzer would weigh less than a 12 pounder, so that it would be easy enough to transport it, for the service of sieges. I, however, think this howitzer useless; for an 8 inch mortar may be fixed at a small elevation, so that its shell may bound like a howitz, or penetrate into masses of earth.

I, therefore, admit no more than 6 calibers for guns, and only 10 for every species of cannon ; even one of these, the 18 pounder, may be suppressed for the sake of economy ; but it weighs less than a 24 pounder, and consumes less ammunition, yet is as serviceable as it, in the defence of places, against the transient works of the besieger ; it also may be employed in some of the operations of an attack, and be of service on some parts of the coast. A 24 pounder is indispensable when breaches are to be made in revetments of masonry.

DEMI-CANNON.

I have given this name to those fire-arms that have perhaps less relation to pieces of cannon, than to the common musquet, yet are not so easy to serve as it is. In this class may be ranked the *Harquebuss* on a swivel, the *Rampart Gun*, and the *Repeating Musket* of the Americans.

The Harquebuss, which nearly resembles the amusette of *Marshal Saxe*, had a barrel like that of a musket, but naked, longer, and more reinforced ; its ball weighed half a pound or more, and its range at an elevation of 4 degrees was 1,000 yards. This weapon was mounted upon a wooden frame, and had a handle fixed to the breech, to point it by. It is no longer used, but might, as well as the rampart gun, be employed in mountain warfare.

The Rampart Gun, or Wall Piece, is a large musket, that was anciently much used in the defence of fortresses. Its barrel is $5\frac{1}{2}$ or 6 feet long ; its ball from 10 to 14 to the pound ; its horizontal range 450 yards ; it weighs about 50 pounds ; it is carried upon a wooden frame, by means of a sort of fork, placed at about $\frac{3}{8}$ of its length from the butt. (No more of these are now manufactured.)

The Repeating Musket is an American gun, that has 7 barrels, each of which fires 32 rounds in succession, making 224 in all. The diameter of the bore is $\frac{3}{4}$ of an inch, and the weight 70 pounds. It is placed, like the rampart guns, upon a wooden frame, and has a handle at the breech to point by. It may be advantageously employed in the defence of places at the moment of assault ; it may also be useful, in the field, to defend parts of a line of battle, or intrenchments, with few troops, and yet astonish the enemy by a warm fire, when he ventures to approach ; but it would be absolute-

ly necessary to have a succession of these muskets to replace those that have fired, for its discharge does not last a minute, and it requires too many precautions, and too much time, to permit it to be loaded under the enemy's fire.

It may, besides, be of great service in the tops of ships of war, whence it would shower musket balls upon the deck of an enemy's ship, in close actions.

This musket has the disadvantage of creating a great smoke, an inconvenience which is less felt in the tops of ships, than in the land service, on account of the current of air.

OF PROJECTILES.

There are two sorts of these, solid and hollow projectiles; among the first are balls and bullets; among the second, are shells howitzes, &c. The diameter of a projectile must naturally be less than the bore of the piece, in order that it may readily be driven home. This difference between the two diameters is called the windage of the ball, or of the piece. It is clear that the diminution of the range, and errors in the direction of the fire, become greater in proportion as the windage increases; several means have been proposed to correct this fault.

1st. The ring-ball of *Guyton de Morveau;* its form is a cylinder terminated in front by a hemisphere; at the junction of this and the cylinder, there is a band of lead, a little thicker than the windage of the piece. When the bullet is forcibly driven into the bore of the piece, the edge of the muzzle cuts off the excess, in the form of a ring, and the interior of the bore is entirely filled by the lead. It is evident that as the windage is entirely suppressed, the range will be greater. Experiment has, in fact, proved that the range was augmented a third; but the cylindrical form of the shot may cause a considerable deviation, as *Hutton* has remarked in his experiments. Besides, even if these balls had all the advantages that are desired, they could only be employed in cases when the fire is slow, but not in the field, because the gun must be loaded with blows of a mallet when they are used.

2d. Circular wedges of wood have been proposed, rammed upon the ball to fill up the void between it and the bore of the

piece, but the results that were expected from the theory, have not attended the experiment. If the balls are rolled in leather, or cloth, the length and the correctness of the range are both increased.

Double headed and Chain Shot.

The first of these is composed of two half balls joined together by a bar of iron; the second is made of two balls connected by a chain. They are employed to cut the rigging and sails of ships. But their aim is so uncertain, that they are of no value except at small distances. Their range is about a mean between that of round shot and grape.

Hollow Projectiles.

Powder is put into hollow projectiles to burst them; incendiary matters are also introduced into them; the fire is communicated by a fuse inserted into the eye, which is lighted by the explosion of the charge. The different kinds of hollow projectiles are, hollow balls, howitzes, shells, and grenades; their sides ought to have a thickness proportionate to the shock they receive in the piece, and to the quantity of powder that can be introduced for the purpose of bursting them; and their weight is in relation to the objects they are to destroy.

Hollow balls are fired against ships to set them on fire, and against earthen ramparts to make holes in them, that form steps, to mount and assault them. In the latter case they cannot contain too much powder, nor in the former too much incendiary matter; on both these accounts, the cavity must be as large as possible.

It has been proposed to reinforce howitzes and hollow balls, intended to be fired against shipping, on the side of the eye, so that it might penetrate foremost, and vomit forth the burning articles with which they are loaded.

Some have wished to introduce hollow balls into the field service, because they will break wooden obstacles as well as a solid ball, and have the advantage of multiplying, by their splinters, the effect of the fire. But if we were to change solid for hollow balls, in the field, the same calibers would have less power and a shorter

range, this would be to augment the greatest faults of small field pieces. If the size of the calibers were augmented, the pieces would then become too heavy; hollow balls, besides, resemble howitzes, in the danger with which their carriage in the Field Equipage, among the ranks of the army, is attended.

Howitzes.

The Howitz is a hollow ball with a *culot*.* It is intended to pass bounding over the ground, striking and penetrating solid objects, and finally bursting, either to destroy troops, perform the part of a small mine, or set fire to houses, parks of artillery, &c.

It has been proposed, that howitzes should be made without a culot, in order that the cavity may contain more powder; but if we admit that a howitz has too much velocity, and strikes the ground too often to allow the culot to prevent it from touching, except on the lower side, and that the fuse is not kept uppermost at the time of the shock, as these innovators pretend; still experiment has shown that the howitz is fired with more regularity, and has a range more extensive in proportion as the distance of the centre of gravity from the centre of magnitude is greater; on this account, the culot of the howitz must be preserved, as it is necessary that the field howitzer should have the greatest possible certainty of aim and length of range; its sides, of course, must not be diminished, for fear that if it be made lighter, it will be less sure of its aim.

As to the cavity, it contains enough of powder to create splinters when fired against troops, is large enough to set fire to villages, and to parks of artillery; it will be only found too small in sieges, when it is fired against parapets to produce the effect of a small mine. In this case, the hollow 24 pound ball, that contains more powder, may be used; and if it does not answer the purpose, it would not be attained by a howitz without the culot. The value

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* The *culot* is a reinforcement of metal, upon the inside of a shell opposite to the eye, intended to make it constantly fall upon the side opposite the fuse. The culot of howitzes is not a perfect segment of a sphere as in shells; its section is connected with the inner figure of the shell by arcs of circles, in order that the weight of the culot may not make the howitz fall too perpendicularly, and thus hinder it from rising.

of the howitz in the field must not be destroyed, in order to make it applicable to the attack and defence of places. If the earth of a rampart is to be violently shaken, recourse must be had to projectiles of a power much greater than these; and the dispute, about an ounce of powder more or less, abandoned; for such purposes, a howitzer that will throw an 8 inch shell, containing 4 pounds of powder, is necessary.

SHELLS.

A Shell or Bomb is a hollow globe of iron, that serves to tear up and overturn the ramparts and parapets of works, into which it penetrates, and there acts as a mine; it breaks gun carriages to pieces, and bursts into numerous destructive splinters; it serves to set fire to houses, and ships, and to crush them, as well as such magazines, as are not so vaulted as to be proof against its power. (For the weights of shells see mortars.)

A shell should have a culot, or reinforcement of metal, opposite to the eye, in order that it may always fall upon that side; without this precaution it might fall upon the fuse and prevent its action; besides shells without culots are apt to break if they fall upon rocks or hard pavements. The cavity of 12 and 8 inch shells contains four times as much powder as will suffice to burst them; this either allows incendiary matter to be introduced into them in large quantities, or the quantity of powder to be so much increased as to form a considerable mine.

A large bomb called *comminge* was formerly used, that weighed 500 pounds; it was powerful enough to crush buildings that were proof against common shells; but its service was so difficult and so slow, and its fire so uncertain, that the use of it has been abandoned; it was 18 inches in diameter, its cavity contained 48 pounds of powder, but 12 were sufficient to burst it.

Grenades.

Grenades are a sort of hollow ball; there are two sorts of them: Rampart or ditch grenades, that are rolled along a trough from the top of the rampart, and fall into the ditch to annoy an enemy

attempting to cross it; they are usually of the caliber of 36, 24, 18, and 12 pounders:

And hand grenades, that are thrown by hand, into the interior of works that are attacked, into covered ways and trenches; upon troops marching to an assault, &c. They are of the calibers of 6 and 3 pounders. Their splinters will fly 35 yards. Six pounder grenades are too heavy to be thrown by hand; these grenades are also fired from small mortars, and may be employed with success in field pieces.

Bullets of Wrought Iron for Guns.

Case shot, for the service of guns and howitzers, are made of wrought iron, because it is less brittle than cast iron, and can be thrown to a greater distance on account of its greater specific gravity. A particular diameter has been fixed for the grape shot of each caliber, in order that a determinate number of them may be arranged in layers, in the cannister that incloses them.

Case shot have to the present time been made of three different sorts of balls, formed into two different kinds of shot for each caliber; the first composed of large balls, intended for long ranges only, the second made up of small and moderate sized balls for less distant service. This causes an embarrassment in the stores of this article, and it has lately been proposed to obviate it by using none but the case of large bullets; these contain 41 shot, and will produce their effect, when fired from field pieces, at a distance of 6 or 700 yards, while the small kind cannot be felt farther than 4 or 500 yards; but, on the other hand, the latter contains 112 shot, so that at small distances, nearly three times the number of small shot will penetrate a given object.

As it is important in close action to render as many men as possible unfit for fighting, whether they act on the offensive or defensive, the case of small bullets is then to be preferred.

A fire with small case shot cannot be opened until the enemy is within 400 yards, while it might be begun with the large while he is yet 600 yards off; and during the time that he takes to march over the additional 200 yards, more than one round may be fired.

It must also be observed, that cases will occur, when it is impossible to approach an enemy near enough to fire upon him with the small grape, and yet the larger would reach him. In such cases the latter is of course preferable; but there are also instances when the enemy remains for a long time within reach of the smaller kind, which have then the advantage.

To reconcile these contending reasons, I propose composing the case shot in such a way as to answer in all cases. The canisters contain at present 41 large balls, ranged in six rows, five of which have seven balls and one six.* If the large balls in the middle were suppressed, and the space filled with small leaden bullets, the cannister would then contain 36 large, and at least as many small balls. If fired at an object at the greatest distance, they will have five large balls fewer, which is but a trifling difference; but if the enemy be at the least distance, they will have at least twice as many.

Of Incendiary Balls.

Incendiary balls, to burn ships and all wooden erections, are composed of an iron carcase filled and enveloped with the incendiary materials compressed to the greatest possible hardness. They will always be less uniform in weight, and in the positions of their respective centres of gravity, than iron balls, nor can their figure be equally spherical. From these circumstances, will result uncertainty of direction, as has been proved by experiment; for out of 33 of them, fired at a mark 400 yards distant, only 10 struck it. It has not been attempted to throw them a greater distance. (*Gassendi.*) In sea coast batteries, hollow balls and red hot shot are preferable for the purpose of burning ships.

Of Congreve Rockets.

For some years past a sort of rockets, called after their inventor, Col. Congreve, have been used. They are 30 inches in length

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* Every row is composed of six balls ranged round the cannister, and one in the middle, except the upper, in which the middle one would project in such a way as to prevent the lid being closed.

and $3\frac{1}{2}$ inches in diameter. A part of their charge consists of fire stone and small grenades. Their range is equal to that of a long gun, but their direction is very uncertain, so much so as to render them of little service, except to set fire to objects with extensive surfaces. They will not pierce through solid buildings, and in battle are at best only fit to frighten horses.

OF SMALL FIRE, AND SIDE ARMS.

Nearly all the nations of Europe have adopted the same arms for their infantry and cavalry.

The fire arms they use are the musket, the rifle, the carabine, the blunderbuss, and the pistol.

The Musket of the French infantry has long been acknowledged as the best; it is light, solid, and will perform a good and lasting service. These advantages are, probably, the result of the great attention paid by the artillery officers, comptrollers, and inspectors attached to the manufactories, to the selection of the materials, and to the inspection and proof the guns and locks undergo, throughout the different periods of their manufacture. These proofs are not delayed until the piece is finished.

It has been said, that the French musket is too short to permit the third rank to protect the first, when it is armed with the bayonet, and used in close action. The best mode of remedying this is to lengthen the bayonet, for the barrel cannot be lengthened without rendering it more difficult to load.*

The American Musket, manufactured at Harper's Ferry, near Washington, is well made, light, and even elegant.

A Rifle has a longer range than a musket, or at least carries its ball with more accuracy; it is very convenient behind intrenchments and among mountains. But it can never be used in the line, nor even by light troops in an open country, on account of the time and trouble required to load it. It is rarely used in Europe.

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* A major of the French artillery is at this moment engaged in manufacturing a musket much lighter and more commodious for the soldier.

A double barrelled Gun, with a bayonet, would be a valuable weapon for light infantry. It is recommended as such by General Roguiat.* A light infantry soldier advances with more confidence when he has a second round to fire close to his enemy. Even if his first shot do not take effect, he will not fear the lance of his adversary, because he may wait his approach to the very muzzle of his gun; the enemy, for the same reason, will be less daring.

A musket, more easily loaded than the common one, would be of use. That which is loaded at the breech, and upon which I have seen some experiments made at Washington, might perhaps answer. Before adopting it, it must be ascertained whether it will stand service in the field, is easily kept in order, and will not wound the bearer.

There are two sorts of *Carabines* for cavalry; I think that is best in which the ramrod is attached to the barrel, by means of a swivel.

The Blunderbuss is a sort of short musket, whose muzzle widens in the form of a bell; it is charged with several small balls or slugs; it is now seldom used; indeed, I know in Europe no troops that were ever armed with it, except the Mamalukes of the Imperial Guard.

A Dragoon Musket is the same with that for the infantry, except that the barrel is four inches shorter, and the mounting of brass.

Foot artillery should carry a *carabine;* a matross ought to be armed for the purpose of escorting convoys and guarding the cannon, not for that of fighing in the line; for this he does not need a heavy musket, nor must it be so long as to prevent him from serving his piece, with it slung upon his shoulder.

The *Side Arms* commonly used are, the infantry broad sword, with a short blade; the broad sword of heavy cavalry, whose blade is straight and long; and that of light cavalry, with a long curved blade. There is besides, the lance, whose blade is about a foot in length, and the staff eight or ten feet long.

The Infantry Sabre is nothing more than an honorary addition to the arms of the grenadiers; a foot artillery-man ought to have

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* *Considerations sur l'art de la Guerre, par le Lt. Gen. Roguiat.*

a strong but short sword, to cut branches of trees to make fascines with, divide ropes, &c.

The soldier of the horse artillery ought to be armed with a broad sword, so that in case of need he may fight on horseback and defend his gun. The light cavalry broadsword is better fitted for him than any other. As this would be in his way when serving his piece, he should have it in his power to hook it to the bow of his saddle.

The Lance (called, by Montecuculi, the queen of arms) is better than any other weapon for militia cavalry, that ought to make war after the manner of *Cossacks;* and should confine itself to harrassing the enemy, by falling upon his detachments, stragglers, and convoys, and cutting up his battalions when in disorder. The foot soldier is excessively afraid of this weapon. General Roguiat, in his Considerations on the Art of War, speaks of it in the following manner: "It was the weapon of the Greeks and Romans, the most warlike nations of antiquity; it was also that of the ancient *gens d'armes*, when they composed the whole efficient force of European armies; it is still the weapon of the Polish and Russian cavalry. The broad sword is less cumbrous, more portable, and more easily managed in the midst of a throng of conflicting horsemen; and I should prefer it in close action; but when a squadron is to be broken, fugitives to be pursued, or infantry to be combatted, the lance, on account of its length, is infinitely preferable. The foot soldier fears this weapon more than the broad sword, and with reason; for when he presents his bayonet to hostile cavalry, he keeps himself out of the reach of their broad swords, but he is not protected in the same way if they carry the lance. Infantry can depend upon their fire alone to repulse a charge of lancers, while they have their bayonets besides to defend themselves from the broad sword. Cavalry then, should be armed with both these weapons; if they are to charge infantry, attack a flying enemy, or overthrow a squadron, they place their lances in the rest; if they are enclosed in a throng of cavalry, they sling the lance upon their left arm and draw their swords."

The lance thus slung upon the left arm covers this weak side of the horseman, and protects him from the blows of his enemy.

OF GUN-CARRIAGES, CAISSONS, WAGGONS, &c.

As the construction of gun-carriages, caissons, waggons, and the other material that is used in the artillery service, is entrusted to that corps, all its officers should have clear ideas of the principles on which their construction is founded, in order that they may reason upon them, and aid in their improvement.

The principal pieces of the carriages, caissons, &c. of the different calibers, should be as nearly alike and equal as possible, in order to facilitate the exchange of spare pieces from one to the other, in the field. Uniformity is still more indispensable in the homologous parts; for instance, the wheels constructed in one arsenal ought to be of exactly the same dimensions as those constructed for the same purpose, in another; any difference between them would be dangerous in the field, inasmuch as it would render any interchange difficult, and might, in a retreat, occasion difficulties, and cause the loss of much artillery.

There are two distinct species of carriages used in the artillery service:

1. Those on which the cannon are carried and fired; they are called gun-carriages.

2. Those that serve to transport ammunition, spare pieces, &c.

A marked distinction must also be made between those carriages that are intended to manœuvre on a field of battle, and those that are to remain in park; between field gun-carriages, ammunition caissons, &c., and travelling forges, heavy waggons, and park caissons. On this account, the wheels, the bodies, and the loads of field gun-carriages, and their caissons, must be planned, in relation to the service they are to render in battle, with a view to rapidity of motion, and to make the manœuvres of the artillery consistent with those of the other *arms;* and not so as to make them conformable to those of other carriages, that are only used at a distance from the field of battle. I do not pretend that they ought to be radically different; indeed, I should prefer them to resemble each other; but in this case, the second sort must be made to conform to the construction that is proper for the first.

Of Wheels.

Three kinds of large, and as many of small wheels, may suffice for the equipage of field artillery, viz.

A large wheel for 12 and 6 pound gun-carriages, howitzers, and ammunition caissons; a lesser one for 3 pounders, and a larger for all heavy carriages.

A fore, or limber wheel, for 12 and 6 pounders, howitzers, caissons, forges, ammunition waggons; a less one for 3 pounders, when they have a limber; and a larger for boat haquets, gun-waggons, and other carriages of that species.

The naves of all the wheels ought to be of the same thickness, so that in case of need they may go upon the end of any of the axle-trees.

Of Axle-trees.

Only 3 sorts of iron axle-trees are needed; one for 12 and 6 pounders, howitzers, and caissons; for the latter the body of the axle-tree may be thinner than in the others, as it has not to support the shock of firing; but its arms must be of the same size, so that the caissons may interchange wheels with gun-carriages, and *vice versa;* a lighter axle-tree is next required for travelling forges, waggons, and other carriages of that sort; and a third for the carriages of 3 pounders.

Axle-trees of iron, being less subject to get out of order than wooden ones, and liable to fewer inconveniences in service, have been generally adopted for all gun and other carriages, used in the field service. The axle-trees of battering guns are made of wood, both for reasons of economy, and because heavy pieces of artillery, when fired, react with violence upon their axle-trees; for the same reason, the axle-trees of howitzers were long made of wood; for this piece, which is fired at a considerable angle of elevation, reacts upon its axle-tree, and fatigues it very much.

FIELD GUN-CARRIAGE. (*Pl.* 6. *fig.* 10.)

The *cheeks* or *flasks*, that are the two principal wooden pieces of a gun-carriage, are slightly curved to decompose the force of the recoil, and diminish its effect. Care must be taken not to cut to too great a depth across the grain of the wood, for fear of weakeningth e flask.

The flasks are bent up and rounded at the trail, in order that they may not be impeded by the roughness of the ground, when firing in retreat, and that the piece may be removed without the carriage being placed upon its limber. A plan has been proposed for rendering these carriages more easy to move, by placing a small wheel at the end of each flask, of the same thickness and in the same plane. During the time of firing, these wheels might be locked by a bolt passing through them; and when unlocked, would enable the piece to be carried forward without raising its trail, and permit it to be more easily manœuvred by means of the prolonge. (*Gassendi.*)

The position of the axle-tree is determined in such a way, that the trail may not be either too heavy to be carried by the men stationed at it, nor so light as to make it troublesome to place it upon the ground when the piece is fired, which would not be convenient.

The gun ought to have a vertical motion, of from 15 to 17 degrees, both above and below the horizontal line; the gun-carriage, for battering guns gives them no greater scope than a depression of 8 degrees, and an elevation of 13 or 14; (for it is supposed that it may be always placed upon a level surface.) The pointing plate of a howitzer, which serves to raise or depress the piece in taking aim, may be removed, and the piece afterwards fixed at an angle of 45 degrees.

The flasks are connected by three pieces of wood, called transoms, that have no mortices; their ends are only lodged to a small depth in the flask, and fixed to it by screw bolts. In this way, the carriage may be taken to pieces, and carried across the passes of mountains, when artillery of a heavier caliber than the 3 pounder is wanted to act on the opposite side of them; the same construction very much facilitates those repairs, the performance of which requires the carriage to be taken apart.

A 12 pounder gun-carriage has a travelling trunnion plate, distinct from that in which the gun lies in action ; the piece is placed in it when it is on the march, in order to divide the weight between the two axle-trees, relieve the hinder wheels, and render the draught more easy. Six pounders, and other small calibers, have no need of this ; their lightness renders it useless ; and thus the trouble of shifting the piece from one trunnion plate to another, at the commencement of an action, is avoided.

Of the Limber.

The limber is so contrived as to change the gun-carriage into a four wheeled vehicle, for the purpose of travelling, or performing evolutions. In order to perform the latter with promptitude, in battle, and at the same time keep the piece in constant readiness for action, the trail is attached to the limber by a strong rope, called the prolonge, and dragged along the ground.

Some limbers are made with an ammunition box fixed to them, others with a moveable one that is placed between the flasks upon the march, and between the bounds of the limber in action. It would certainly be preferable, not to be compelled to change the position of the box, but the limber with a fixed one, has many inconveniences ; for the box must be placed in front of the axle-tree, so that when the piece is in motion, the pole vibrates continually against the head of the horses and the legs of the driver, fatiguing them, and wearing out the limber. These disadvantages incline me to prefer the moveable ammunition box, carried between the flasks when marching. The partizans of the fixed box say, that it may be made larger than the other, and may, therefore, carry more ammunition along with the piece ; but if it were adopted, it would not do to commit the fault of rendering the gun-carriage still more heavy, and, in consequence, less rapid in its manœuvres, and less in harmony with the other arms, by making of it a little caisson.

I would propose to place three rounds of grape shot in the small triangle formed by the bounds and the body of the axle-tree, in order that this projectile may not be wanting in a moment of emergency. I have several times been charged by cavalry when there was no case shot in the box, and none could be procured in time from the caisson ; but if a charge of grape shot had been at

hand, that could have been used over a ball or other cartridge, it would have been easy to repulse the cavalry. These bullets had better be enclosed in linen bags because they will then diverge sooner than when they are enclosed in tin cases, and of course produce a greater effect upon an enemy close at hand. From 150 to 200 common grape shot may be put into each sack.

MOUNTAIN GUN CARRIAGE.

This sort of carriage is intended for other purposes, than to be carried, when marching, upon the back of a mule, and to be taken down merely to fire the piece from. It must besides be so arranged that it may carry the piece where the nature of the country will permit, and follow the movements of light troops in level ground. A small carriage with light wheels, that may either be drawn by means of shafts without a limber, or have a limber attached to it at pleasure, will fulfil both of these conditions.

Some portable gun-carriages rest upon a wooden frame or *chevrette*,* instead of wheels; but they cannot travel; they must be carried continually, and used only for firing. The carriage with wheels is preferable, because the piece, when on it, is raised higher, does not turn over when it is fired, and can travel upon it.

This carriage ought to have a pointing plate, that may be fixed in three different positions, in order that the piece may be directed with ease, either very much below or very much above the horizon; which is often necessary in mountainous countries.

SLEDGE CARRIAGE.

Besides portable mountain artillery, it may happen that larger pieces are sometimes wanted in mountainous countries where the common gun-carriage cannot be used; in such cases, field 6

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* *The Chevrette* is a sort of frame, composed of four pieces of wood mounted upon two truck wheels, that is attached to the carriage by means of two iron branches and a bolt; its use is to raise the front of the gun-carriage when the gun is fired.

pounders and howitzers must be employed, and a sledge carriage, on which the piece is both carried and fired.

The sledge gun-carriage is composed of two flasks joined together by three transoms, like those for other purposes; it is supported by two truck wheels placed at the trail; the front of the flasks is dragged along the ground; when the piece is used, the end of the flasks is supported upon a wooden frame or *chevrette*, with truck wheels, but sometimes large trucks are used instead of the chevrette.

The truck wheels of the trail are pierced with holes, so that they may be locked during the time of firing; within the flasks are two drag chains that hold the swivel tree to which the horses are harnessed. In the middle of each chain is a large ring where a lever may be placed, another lever is passed through the battle trunnion plates, covered with their cap-squares; by means of these, this gun-carriage may be carried by men in difficult passes. The howitzer may be fired without either wheels or wooden frame, and at a great elevation, by taking away the moveable pointing plate.

"The 12 pounder is too heavy to be mounted upon a sledge gun-carriage without wheels; attempts have been made to introduce it into the war of lofty mountains, by making use of one, with high trucks towards the chace of the gun, and others not so large under the trail, to which are attached a pair of shafts. These last truck wheels are made so low as to turn under the gun-carriage. But this kind of carriage can only be used to fire from, because in spite of the utmost strength that can be given to the truck wheels, they are easily broken by the great weight that they must carry, and the shocks they undergo upon rough roads; neither can the low truck wheels of the limber surmount the stones and rocks that often impede their course among mountains; in consequence, when this carriage was used, it became necessary to keep it for firing from, and to carry the piece, when travelling, upon a sledge; (this had its trucks placed in the middle, which made it vibrate constantly when on the march, whence its name in the French language, *traineau à bascule;*) but the labour that attended the change of the piece from the sledge to the carriage, and vice versa; the difficulty and danger of holding it back in rapid descents, by means of a retreat rope; for locking the trucks would render the draught

heavy; made the service of this mountain carriage very laborious." (*Gassendi.*)

This sledge was also used to carry the 8 inch mortar, whose weight being condensed upon a small part of the carriage soon destroyed it; it would have been better to have made a sledge that would have served both for the carriage and the service of the mortar in firing, by the removal of the trucks, than to have two sorts of carriages for the same piece.

Observations.

"Colonel *Laurent* has proposed, (in France,) a gun-carriage with a single iron flask, that is nothing more than a strong square bar bent into the form of a wooden flask. This carriage would serve for any caliber by merely changing the block trunnion plates.

"The scheme was plausible, but a little reflection destroyed the illusion. No care will prevent flaws in a piece of hammered iron of such a size and pattern; but were it free from them, the very best iron will freeze, and snap off in cold weather, with the slightest shock; but if the piece is fired in the winter, it must undergo violent ones. The breaking of such a flask, too, is attended with the worst consequences, so that although the contrivance is ingenious, it is not good." (*Gassendi.*)

Many contrivances have been thought of, to construct the field carriage in such a way that it may constantly rest upon all its four wheels, and thus always remain attached to the horses. The object to be gained by this would be a greater facility in manœuvring; but none has yet been discovered that would answer. General Montalembert proposed a gun-carriage of this sort, but it was too lofty, too easily overturned, too heavy, and, in short, inadmissible.

BATTERING GUN-CARRIAGE.

Battering are similar in form to field gun-carriages; they differ merely in the former being a little longer, and a little more charged with wood and iron, in proportion to the bulk of the piece, than the latter. The axle-tree is of wood, for the reasons that have already been given under the head of *Axle-trees;* the limber

does not carry an ammunition box; the piece does not travel upon its carriage, but there is a separate waggon to carry it when on the march.

The artillery men are much less exposed, when defending a rampart, if Gribeauval's garrison carriage is used (plate 6, fig. 6.) instead of this. It raises the gun in such a way as to fire over a parapet high enough to shelter the men, without making embrasures, or else such shallow ones as do not expose them. But it cannot be used in the attack, in its present form; because the men, who are not sheltered while loading the piece, would be soon destroyed, and the guns dismounted by the fire from the rampart of the besieged, that commands the besieger's batteries. This inconvenience might be remedied by making the wheels eccentric, or constructing embrasures; but this last method would require the epaulment to be considerably raised, and would, in consequence, render the erection of the batteries longer, and more difficult.

Of Eccentric Wheels.

"The gun-carriage, with eccentric wheels, contrived by Colonel La Grange, is an idea as valuable as ingenious; it may become of the greatest use in artillery, and save many valuable lives. (I only speak of this carriage in relation to the wheels.) The nave is not in the centre of the wheel: it is 5 feet 8 inches in height; the difference between the height of the longest and shortest spoke is 14 inches. (*French.*) When the gun is to be fired, the wheel is made to rest upon the longest spoke, and fires easily over the epaulment; when it recoils, the wheels turn and bring the short spokes down, the piece sinks, and the matross is well covered by the epaulment when he loads, which is an incalculable advantage.

"The following objections have been made to these wheels:

"1. That they render the piece more difficult to run up to battery, because it must be raised upon the long spoke.

"2. That there is a difficulty in making the wheels turn together, when the carriage is moved, in such a way as to bring equal spokes always opposite to each other; and without this, the piece will be inclined to one side.

"3d. That the carriage must have centric wheels to travel upon, which would much increase the weight of the equipages."

General Gassendi answers the first of these objections, by saying that the same number of matrosses can, with but little additional exertion, run the piece to battery, that the levers may be lengthened, &c. The second, by proposing to raise the axle-tree by means of a jack, when the equal spokes that ought to be painted of the same distinguishing colour, may easily be brought opposite to each other.

"The third objection is the strongest. Colonel Lagrange ought to obviate it. But until he does so, it may be urged, that it is of no consequence in fortresses, where a few pairs of centric wheels may be provided to change the position of the carriages; that the naves of the wheels may be made of an oval form of two pieces of wood, and pierced with two boxes, one in the centre to travel upon, the other eccentric to be used in battery." (*Gassendi*, page 32.)

The gun carriage with eccentric wheels, was examined in France, in the year 1807, and was well liked by the officers present at the proof; but it was neither approved nor rejected; so that these wheels are commonly looked upon as merely ingenious, and not likely to be of value in service.

It has been proposed to preserve the common wheel, and yet give the gun-carriage the advantages it would gain from eccentric wheels, by means of a curved axle-tree, whose axis should be $6\frac{1}{2}$ inches distant from that of its spindles.

GARRISON CARRIAGE. (pl. 6. fig. 6.)

This carriage is composed of two short, and very high flasks, with two large wheels in front, and a truck wheel under the trail; it rests upon a platform frame composed of three grooves, in which the large, and truck wheels move. The horizontal motion of the piece is produced by moving the platform, and not by the motion of the carriage alone; to effect this, bolsters, and a transom pierced by a pintle bolt, are placed under the position of the axle-tree of the carriage when in battery, so that the axis of motion may pass, as near as possible, through the center of gravity of the whole weight

that rests upon the frame; and the piece be thus more easily pointed.

This carriage raises the piece more than 5 feet above the bolster, and renders embrasures unnecessary, or requires very shallow ones; it, in consequence, shelters the troops better than any other. It has been said, that it is too heavy; that it offers a much greater surface to the enfilading fires of an enemy, than the battering gun-carriage; it is also blamed on account of the difficulty with which its horizontal motion is produced; but its advocates maintain, that this last is rather an advantage, because the gun mounted upon it must continue to fire during the night, upon objects to which it has been pointed during the day.

Note.—A carriage has been constructed in France to be used in either the attack or the defence of fortresses; it was called camel carriage, and also *flêche* carriage; but it has died with its patron, General Faultrier, who introduced it from Egypt. It was still higher than the above described garrison carriage, extremely heavy, very complicated, difficult, and even dangerous to manœuvre; which, with other faults, have caused its suppression.

SEA COAST CARRIAGE. (pl. 6. fig. 7.)

The sea coast carriage has two flasks, that resemble those of the garrison carriage; they are mounted upon two rollers, on which the carriage moves backwards and forwards, upon a large frame that revolves round an axis, to give a horizontal motion to the piece. This frame rolls upon two truck wheels, placed under its trail; its front lies upon a smaller frame, to which it is attached by a pintle bolt.

This carriage is much more easily moved than the garrison carriage, and has a larger field of fire; with it, a vessel passing before the gun may be followed almost as readily as by a man with a musket; this is a condition indispensable in maritime defence.

Marine Gun-carriages, for Sea Coast Service.

The marine gun-carriage may also be employed upon the coast, in case of need. It requires but little time to construct it, consumes no great quantity of wood or iron, but has the faults of being difficult to manœuvre, of requiring more men to serve it, and a platform; it also exposes the men, for sea coast batteries should, in general, be made without merlons, to give them a greater field of fire, and these carriages are very low.

Carriages to fire Guns at an elevation of 45 Degrees.

Marine gun-carriages have been used upon the sea coast, that fire at an angle of 45 degrees. The transoms are shaped so as to receive the gun elevated to that angle; the flasks are cut into steps as in the sea coast carriage, so that the piece may be laid in any other position, by putting joists upon these steps; it is supported in the position at which it must be loaded by means of a fork on which the button of the gun rests.

Pieces may be fired at an angle of 45 degrees, in a much more simple way. (See the *Exercise of Sea Coast Guns.*)

CASEMATE GUN-CARRIAGE. (pl. 6. fig. 9.)

A gun-carriage for casemates ought to fulfil the following conditions:

1. It should occupy the least possible room behind the epaulment, so that the size of the casemates may not be uselessly augmented, and room for lodging troops may be left in them.

2. It should have the greatest field of fire, and its embrasure the least exterior opening possible, in order that the gunners and the carriage itself may be less exposed to the enemy's fire. The horizontal motion, too, should be easy.

Among the great number of gun-carriages that have been proposed for casemates, we shall mention those of General *Chasseloup*, and Mr. *Reveroni*, which swing upon a pivot, in such a way that the piece is raised high enough to fire, from an epaulment that covers the men completely, or from a lofty embrasure, and is then lowered to be loaded. As these gun-carriages have not yet receiv-

ed the sanction of experience, we shall not dwell longer upon them.

The other gun carriages used in casemates are, the marine gun-carriage with modifications, and those invented by Montalembert, and General Meunier, called (*affuts à aiguille*,) needle gun-carriages.

These carriages have two flasks mounted upon a frame, much in the way of the sea coast carriage, of which we have spoken, but from the middle of the foremost transom of the frame, a piece of wood projects, that is pierced, at its extremity, with a circular hole to receive a pintle bolt, round which the frame revolves upon four truck wheels, two placed beneath its front, and two beneath the trail. This piece enters beneath the sill of the embrasure, and is called the needle; it should be so contrived as to bring the muzzle of the piece as far forward as possible, in order to diminish the exterior opening of the embrasure, without lessening the field of fire. It may be easily seen, that the distance this needle ought to enter into the thickness of the wall, or epaulment, must depend upon, the length of the chase of the piece, the dimensions of the frame, and the thickness of the shelter. In the carriage of General Meunier, that is used in the casemates at Cherbourg, the great frame is shorter than that of the sea coast carriage; the ends of the rollers, and of all the pieces that project from the side, are suppressed, in order to save room. Within the great frame there is a less one, contrived to facilitate the motion of the piece into battery. (In the third volume we shall give the plan and the detail of this carriage.)

MORTAR BEDS. (pl. 6. fig. 8.)

Mortars fire at a great angle of elevation. This occasions a violent reaction upon their carriages, which must, in consequence, be very solid. They are composed of two short flasks, connected by two transoms, and two screw bolts with nuts. The flasks of heavy mortars are of cast iron, and the transoms of wood. These flasks, however, sometimes break, in consequence of the violence of the shock; to obviate this inconvenience, it has been proposed to make false trunnion plates, that should first be covered with lead or copper, and over that with the true trunnion plates of wrought iron; it has also been proposed to mount the bed upon two iron

rollers, to permit it to recoil. Beds with wooden flasks have been made for large mortars, but they are much more subject to be damaged or destroyed.

The flasks of 8 inch mortars, as well as those of stone mortars, might be made of wood, but it is more usual to make them of cast iron.

The elevation is usually given by means of a wedge, but some heavy mortars have a winch on the front of the bed that answers the purpose.

Twelve inch mortars, with a bed cast upon them, are pointed by means of a large wedge formed of several pieces of timber, well fastened together by bolts ; it is placed upon the platform.

CARRIAGE OR WOODEN HORSE FOR DEMI-CANNON.

The carriage, or rather the horse, for harquebusses and rampart guns, is like the bench used by sawyers. It is composed of a piece of wood, named the body, one end of which rests upon the ground, and the other upon two wooden feet. The head is bent, and has a hole bored into it to receive the swivel, on which the weapon rests.

OF CAISSONS.

The caisson is a carriage whose body is a long covered and close box ; and there are two distinct kinds, the ammunition caisson, and that which is generally called the park caisson, which, according to its load, is known by the name of a caisson of fireworks, tools, &c.

Ammunition Caissons.

The proper form for this carriage, that is intended to transport ammunition for the service of batteries of field artillery, is still a desideratum. Many attempts have been made to construct one that should not spill as much powder, nor be as difficult to turn as that of Gribeauval, (now used in France,) yet be, at the same time, strong enough to perform the service required of it in the field. A hundred different ways have been proposed to hang the coffer,

or body of the caisson, and to make the wheels turn beneath it; such as pudding, plate, and cradle springs, broken, bowed, and arched braces, and other methods, very ingenious, but which were either impracticable, or rendered the caisson too weak for service. Let us examine what are the qualities of a good caisson, and how they are to be given it.

The principal conditions attained by a caisson are: 1st. To preserve the ammunition from waste or damp; 2d. To be light enough to follow its piece at all times; 3d. To be able to turn as short as possible, to run no risk of upsetting in rapid movements, and not be too high to allow the ammunition to be easily reached.

1st. It has been found, that if the bag is well made, the stuff close and free from holes, and the caisson carefully packed with tow, the powder will not sift out; and that if these three essentials are wanting, hanging the carriage upon springs will not prevent that inconvenience, but will only lengthen the time required to produce it. Besides, according to Gassendi, if the caisson is hung upon chains, the jolts are quite as violent; and if on leather, they lengthen, dry, rot, and finally break, thus increasing the difficulty.

In order to avoid the accidents that take place, in consequence of the powder sifting through the bags, we may adopt the caisson proposed by General Gassendi, with a false bottom, distant about $\frac{1}{4}$ of an inch from the true one, and pierced with several holes, to facilitate the passage of the powder that may sift through the cartridges. A hole should be made at one of the ends opposite the space between the two bottoms, through which the powder might be withdrawn; to facilitate which operation, the bottom of the caisson might be inclined a little.

The better to preserve the ammunition from damp, it has been proposed to pack it in small wooden boxes, placed in the caisson; this, however, is a useless augmentation of the bulk and weight of the box.

I have seen much service, and my ammunition has never been spoiled in the caissons, for want of these boxes, care being taken to air and examine it often. The lid must be covered with leather; sheet iron is not so good for the purpose; it rusts and is eaten away. Shutters may also be placed within the lid.

2d. A six-pounder gun-carriage, with its piece, implements and

the box loaded with ammunition, weighs about 2,700 pounds;* but the best horses are usually harnessed to it, and a caisson drawn by four weak and tired horses, ought to be at least a fifth lighter, in order to travel as fast as it does; the piece, besides, will receive more aid from the matrosses in heavy roads. On these accounts, the caisson ought not to weigh more than 2,200 pounds.

In order that the wheels may turn under the wooden braces, on which the caisson rests, they ought to be raised about 4 feet from the ground, which is the height of the small wheels. This may be easily effected by means of wooden bolsters upon each axle-tree, but the upper edge of the caisson would be then so elevated that the ammunition could not be easily got at. On the other hand, if the diameter of the small wheels were diminished to effect this purpose, they would clog in the ruts, and the carriage would draw heavily.

Some have advised that part of the bottom of the box of the caisson should be hung below the braces, by means of iron stirrups, and that the elevation of the upper edge should be diminished as much as the bottom is lowered; the ammunition would then be easily reached, and the wheels would turn under the braces, in front of the suspended part of the bottom; the part of the box over it would serve to contain the powder in its cartridges, while the front, whose bottom rests upon the braces, would hold the shot. But this mode of construction is not strong, and can besides be used only when the projectile is not attached to the powder, a practice I cannot approve, for by this separation the service of the piece becomes complicated, and may often cause great delay. The caisson I shall describe in the third part of this work, is that which has, up to the present time, best fulfilled the requisite conditions.

Wheels. The Caisson constantly accompanies its gun, so that its large and small wheels ought to be similar to those of gun-carriages, by which arrangement, an exchange of pieces may take place between them, and they may mutually aid each other. If

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* I take a six-pounder for the standard, because it is the piece that follows the movements of troops.

there is any difference in the size of wheels, it must exist only in those carriages that do not manœuvre on the field of battle, and never act along with the guns.

Why should the caisson have higher wheels than the gun-carriage? The caisson, when loaded, ought to weigh less than the gun-carriage and its piece, so that it is not required by the weight of the former, and moreover an addition of two inches to the radius of the wheel, makes no sensible difference in the draught.

Two Wheeled Caisson.

Some caissons have only two wheels, such as those of the Russians; they are light and of a rapid motion; but they have the inconveniences common to all carriages with shafts, of soon ruining the thill horse, and breaking the shafts if he falls. Besides, twice as many of them are wanted as of the others, for they can carry only half the quantity of ammunition; this produces the great inconvenience of increasing the impediments to a march, and lengthening the columns; it is of no use to have a caisson that can move more rapidly than the piece itself, so that this caisson is only of value for the three pounder, to which gun its weight renders it exactly fitted.

Wurst Caisson.

The Wurst Caisson, that was employed on the first introduction of light artillery, is narrower than the common caisson, and contains no more than half the quantity of ammunition. The body is hung on springs; the upper part is rounded, and covered with leather, to serve as a saddle for the matrosses; a plank that extends along the two sides serves as stirrups. This mode of giving velocity to artillery, is subject to inconveniences, that have caused it to be suppressed; if the caisson be set on fire by an enemy's projectile, or in any other way, when the matrosses are upon it, they will be all either killed or wounded; when the caisson is broken, the men must walk on foot; if, on the other hand, they are mounted on horseback, they are never all subject to the same danger at a time; are never separated from their piece; and may defend it and themselves, sword in hand; they may also

await the near approach of the enemy, because they can retire more easily.

Park Caisson.

The Park Caisson is employed to transport the tools of the workmen of the Corps of Artillery, in the train of a Field Equipage; and edged tools, fireworks, small stores, &c.; it also serves to carry ammunition for cannon, infantry cartridges, &c. along with the parks.

This caisson never follows the pieces, and therefore need not be as light as the ammunition caisson, nor turn as short; it may, in consequence, have a greater interior capacity.

With this carriage commences the difference in the wheels, that forms the line of demarcation between those carriages that are used in battle, and those employed for transportation only.

CART CAISSON.

The Cart Caisson is nothing more than a cart with two wheels, that is used to transport ammunition, contained in well closed boxes. It is covered with a stout painted cloth to shelter the boxes.

This cart is used instead of the ammunition caisson: in those expeditions that require them to be embarked; caissons are, in such cases, very embarrassing; it is often impossible to put them through the hatches of vessels: in mountainous and difficult countries, to transport ammunition in the parks that follow armies; but not in batteries, to follow the piece: it is cheaper and less cumbrous than a caisson.

Box for carrying Ammunition.

A loaded box ought not to weigh more than 110 pounds, in order that two of them may, in case of need, be carried by a mule or on a horse; and because a greater weight would soon weary the arms of two men, if it were to be carried any distance by hand, (it may hold 10 six pound ball cartridges.) The box ought to have a false bottom, with holes pierced in it, to permit the passage of the siftings from the cartridges, and thus prevent accidents; the powder is taken out through a hole bored at one end. The top has the form of a penthouse, and is covered with a painted

cloth, that reaches some inches down the sides, in order to shelter the ammunition from moisture.

These boxes may be carried in carts; and on the backs of mules in countries where carriages cannot travel; this is very advantageous, and allows ammunition to be transported in every possible sort of ground.

DIVISION OR STORE WAGGON.*

The Division, called also Store Waggon, is a four-wheeled carriage without a cover, and whose sides are like a rack; it is used in the train of field batteries, to carry those spare articles that ought to be provided, and also pioneers' tools; it is also used in the park to carry stores. As this carriage must move along with the batteries, it ought to be so light that its load may not exceed 1,200 pounds; its interior capacity ought to be regulated in consequence, for the more it is able to carry, the heavier will be its load; it will then either be left behind, or will delay the march, and ruin its own horses. Let the waggons for spare articles, tools, stores, &c. that follow the park, be large, if it be wished to reduce their number; but let all the carriages that accompany Field Batteries be light, (about the weight of a six pounder and its carriage.) The wheels and axle-trees may be the same both in park and battery waggons, and their difference may consist in the size of the body of the carriage.

TILTED WAGGON, (*Fourgon.*)

The sides of the Division Waggon are sometimes raised and covered with a tilt; the French then call it *Fourgon*. It is used to transport clothing, belts, &c., and all those articles that must be sheltered from the weather.

TRAVELLING FORGE.

The Travelling or Field Forge, is a four-wheeled carriage that carries the implements and materials used in the repair of the iron work of gun and other carriages, in the field. It ought to be as

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* It might rather be called *Battery*, than *Division* waggon, because it marches with the former.

light as possible, particularly if it is to accompany a field battery: it need not be very large, nor does it want many tools or materials, to be sufficient for the repairs required by about 30 carriages, while on the march.

Forges upon two wheels were formerly made, but they are now disused. Some forges are made so as to be portable on the backs of mules, for the service of mountainous countries.

OBSERVATIONS.

It is a very common fault to make the division waggons and travelling forges too heavy. It seems as if it were a matter of pride to carry as much as possible in these carriages, when they ought rather to be made as light as they can conveniently, and carry no more than is indispensable for a field battery; for this purpose but little is wanted, because many articles may be replaced as fast as they are used, in the country where the war is carried on; but I repeat, that the carriages must not be larger than is absolutely necessary, or they will be always filled with articles that have no business in them; they become then nothing more than a general receptacle for the effects of the soldiers and non-commissioned officers.

GUN WAGGON OR BLOCK WAGGON.

This is a four-wheeled carriage, composed of nothing more than fore and hind wheels and axles, united by two wooden braces. Of these waggons, there are three different sorts or numbers.

1st. The gun waggon, mounted on large field-carriage wheels, to carry battering, garrison, and sea coast guns, upon the high roads.

2d. The gun waggon upon battering limber wheels, to carry guns in fortresses.

3d. The truck gun waggon, to pass cannon through posterns and into the different works of a fortification.

THE CANNON BALL CART, CAMION, &c.

Are two-wheeled carriages that serve to carry projectiles, powder, tools, wood, mortars, &c. In sieges they are preferable to waggons, on account of the ease with which they are unloaded by drawing the rungs.

There are three sorts of these carts, only differing from each other by their different lengths; the width is the same in all. The first is made for the purpose of carrying the materials for platforms, pioneers tools, &c.; the second, which is shorter, to carry cannon balls, shells, mortars, and their beds, it is called a camion; the third is the shortest, and serves to carry prepared ammunition packed in boxes; it is the same with the cart caisson, of which we have spoken.

THE HAQUET FOR BOATS.

Is upon four wheels, and carries the boats that are intended to make bridges over rivers.

PORTABLE BRIDGE.

There is also a portable bridge, which is a carriage, that of itself makes a bridge over small and shallow streams. It carries all the materials required for this purpose.

SLING CART.

The sling cart resembles a limber with its pole, but the wheels are seven feet high, and the pole 15 or 16 feet long: It is a lever of the first sort, and is so much the more powerful, as the arm on which the power acts, is very long in proportion to that which carries the weight. The weight is fastened to a wooden seat, upon the axle-tree. The screw sling cart is the same in every respect, except that there is a screw in the back of the seat to raise the load, and carry it, by the help of chains and eyed bolts. There is also a sling cart, with cart wheels, whose pole is only 10 feet long. The ordinary purpose to which sling carts are applied, is to carry heavy cannon and other great weights in fortresses.

TRUCK WAGGON.

The truck waggon is composed of three planks, mounted upon four truck wheels, and is used to transport mortars and their beds, guns, and other articles, when the distances are small and the roads smooth.

SLEDGE.

The sledge is a sort of carriage without wheels, to carry loads either in fortresses or in the field; it is composed of two long runners or flasks, connected together by cross pieces, or transoms and bolts. There are three different kinds of them.

1st. The common sledge, for the service of fortresses, arsenals, &c.

2d. The sledge upon rollers, that is used in posterns, and to mount the narrow ramps of fortifications.

3d. The mountain sledge, that, when necessary, carries cannon and the bodies of caissons. (See *Sledge Gun Carriage.*)

CAPSTAN AND WINDLASS.

The wheel and axle is a machine, composed of a cylinder or roller fixed between two flasks or frames, that serves to overcome a resistance by means of levers, and of a rope wound round the cylinder. Of these, some are horizontal, and called windlasses, that raise and lower weights; others vertical, called capstans, that act in a horizontal direction. The last is used particularly to haul taught the ropes to which floating bridges are attached. It has the greatest power, because its arms may be lengthened at pleasure. Upon an inclined plane, (for example,) whose height is to its length as four to six, three thousand pounds may be drawn by this machine with a force of 50 lbs. The diameter of the axle or cylinder, ought to be in direct proportion to the size of the cordage.

THE SCREW.

A screw, or screw jack, is a machine to raise weights; it is very simple, yet has great power. It is composed of a winch, that, by means of two pinions and one wheel, gives a perpendicular motion to an iron bar with teeth. This iron bar will raise a weight, resting upon it, whose proportion to the power is, in the ratio of the product of the radii of the wheels, to the product of the radii of the pinions, the winch being considered as a wheel. The radius of the winch being 15 inches, and that of the wheel 12, a force of 50 pounds, which is about that which a man exerts in turning a winch, will raise 3,000 lbs. (*Manuel d'Artilleur.*)

OF THE GIN.

The gin is also a machine to raise weights; it is composed of two legs joined together by three traverses, of a roller between them, and a pully at the fork; there is a third leg called the foot of the gin. Its principal use is to mount heavy guns on their carriages, and on gun waggons. There are two sorts of gins.

That which may be taken to pieces for field service.

And that which is always fixed for the service of fortresses.

As the manœuvres of a gin may be seen over an epaulment, General Gassendi proposes to substitute for it a strong compound lever, made of two or three separate pieces easily put together. A fulcrum three feet high, carrying a vertical bolt, will serve to support the lever, which must have, towards one end of it, a conical hole to receive the bolt; by means of this lever a piece may easily be raised and placed upon its gun carriage, taking care to lift it by the dolphins.

THE JACK.

The jack, or lever jack, is commonly used to raise the axletrees of carriages, to remove or put on their wheels. It is composed of one or two vertical planks placed upon a base, and furnished with a lever 12 or 15 feet long. The fulcrum is a bolt that passes through one of the planks. For these jacks, and their levers, an upright bit of plank, called a pointal, on which a common handspike rests as a fulcrum, is frequently substituted, to take wheels off their axles.

PILE DRIVER.

The pile driver is composed of 4 arms, and 8 handles, that serve to raise the weight that is to be let fall upon the pile, to drive it in.

MISCELLANEOUS MACHINES.

Several other machines are used in the artillery service, such as tumbrils; handcarts; wheelbarrows; handbarrows, with and without legs, with spar or sacking-bottoms, to carry shells, barrels of gunpowder, &c.; grates for heating balls red hot; rampart lanthorns, &c. These are too well known to need description, so we shall say no more of them until we treat of their construction.

Track of Carriages.

The track of carriages, or breadth of the road on which they travel, is measured on the ground, from the inside of the fellie of one wheel, to the outside of that of another.

The ordinary track of artillery carriages is five feet wide: the gun waggon, and the boat haquet, are made ½ an inch narrower, because the heavy weight with which they are loaded, soon brings them to the common width.

Attempts have been made to construct carriages, in such a way as to have tracks of two different widths; this was effected by means of hollow cylinders upon the axle-tree, the removal of which would permit the track to be narrowed 8 inches. This plan has been disapproved of, and one track has been considered sufficient for all field carriages.

Of the mode of Harnessing the Teams.

There are two ways of doing this, by means of the pole, or by means of the thill. Each of them has its peculiar advantages and defects.*

"If the horses are harnessed to a pole, the draught is equally divided among them, and they have room to move their limbs; no more than half the number of horses move in the same track, which lessens the length of the columns one half; this method gives the postillions greater power over their horses, and is preferable in manœuvring; besides, the horses may gallop. The inconveniences that have been remarked, are, that the horses must often march in the ruts, and stepping less firmly there, will draw unequally; and that, in rough countries, the poles are so easily broken that it is difficult to furnish a sufficient number of new ones.

"Thills are not so easily broken; therefore, the artillery makes use of them in mountainous countries; but they lengthen the columns, because the horses march in a single file; the driver guides two horses with great difficulty, which renders the thill less pro-

* It is well known that the pole is a piece of wood fixed to the middle of a limber, or fore carriage, in such a way that the carriage may be drawn and guided by a horse placed on each side of it. The thill is composed of two shafts, that receive a horse between them.

per for manœuvring; the thill horse is soon ruined, for he is struck by the vibrations of the shafts, has the whole weight of the carriage to support in descents, and on the summit of ascents is borne down by the weight of the leaders, who draw through his collar, and force him to step into holes, &c.; besides, it is impossible to gallop with a thill, and even a trot is performed with difficulty.

"Spare poles are easily carried; thills are not: the latter is twice the weight of the former, and it costs three times as much."

In mountainous countries, however, the thill is best, and difficulties arise from the want of them; it is also troublesome to carry them, as spare pieces, and travel to the foot of the mountain with the pole; a mode, then, of harnessing the team, is wanted, that may unite the advantages of both the pole and the thill. (*Gassendi.*)

I see no other way, for my part, than to harness the horses to thills when it is known that they will be necessary, and to place them three abreast, in order to diminish the length of the column.

Note.—The preceding paragraphs are merely a sketch of the articles of which the material is composed, but when the third part of this work is published, I shall give the dimensions of cannon, small arms, gun carriages, caissons, &c. and enter fully into the consideration of their form and construction.

ORGANIZATION OF THE PERSONAL OF ARTILLERY.

1st. The force of a company of artillery should be calculated from the number of men necessary for the service of a Field Battery, and not with regard to the service of the cannon of fortifications, where the number and kind are not constant, and where the number of men required to serve them, varies in every particular case.

2d. The number of companies must be regulated by the number of batteries that will be necessary in the field in time of war, and the number of men that will be required for the service of fortresses.

3d. The number of regiments into which these companies are embodied, must be determined by the number of the great natural or military divisions of the territory to be defended; each of these will form a province, where a regiment must be placed as centrally as possible, so as to supply with ease the armies, strong places, and forts, that are within its district. To make this more evident, let us suppose that a country has five exposed points, upon its frontier, to be guarded, while its artillery is divided into only two regiments, embodied at two of these points; in what way can it provide for the defence of the remaining parts of the frontier? What embarrasment will it not be exposed to at the breaking out of a war? And what risks will its distant frontiers not run? If the companies are distributed along the frontier in the fortresses and posts, they will remain without instruction, and be unworthy the name of artillery.

COMPOSITION OF A COMPANY OF ARTILLERY.

The force of a Battery of Field Artillery should not be more than eight pieces, nor less than six. I shall consider it as composed of six pieces, as it is in that case more manageable, and better fitted to perform its evolutions.

Nine men, including the artificer who has charge of the caisson, are sufficient for the service of any field piece ; but it is proper to have at least 11 or 12 men to each cannon at the opening of a campaign, so that it may not become necessary to diminish the number of guns, if the war be carried on at a distance from the recruiting depots.

On this principle, a company of artillery, whether of horse or foot, in order to serve a battery of 6 field pieces, ought, at its minimum, to be composed as follows, viz.

1 Captain Commandant.
1 Captain Lieutenant, (he is employed in time of piece in arsenals, &c., to learn the construction of the material, and in time of war, is with the parks, or serves upon the staff.)
1 1st Lieutenant.
1 2d do.

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4 Officers.

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1 Orderly Sergeant.
3 Sergeants,* (one to each section of 2 pieces, composing a squad.)
1 Quarter Master Sergeant.
6 Corporals, (*or Brigadiers*,) one to each piece, who commands it, superintends its service, and takes care that every thing is kept in good order.
3 Workmen who make such repairs as can be performed in the field.

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* The division of a company into 4 squads for the service of a battery of 6 pieces, as it exists in some countries, is not good. A company should be divided conformably to the service it is to perform ; there are 3 sections of pieces ;

2 Drummers or trumpeters. (They, and the workmen also, are instructed in the exercise, and assist in case of need in the service of the piece.)

24 Matrosses of the first class, of whom 18 are gunners and 6 artificers.*

42 Matrosses of the 2d class, (3 of whom are apprentice workmen, and 3 apprentice artificers, but all six assist in the service of the piece.)

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82 non-commissioned officers and soldiers.

Two additional matrosses are required to each piece of horse artillery, to hold the horses of the men who work the piece, so that a company will consist of 94 men, of whom 2 are smiths. The horses of the gunners and matrosses have a breast plate, and traces hidden under the housing, by which they may be harnessed to the pieces in case of need.

Observations. One artificer is required to each piece to direct the caisson, and distribute ammunition to the purveyors during the action ; one to every two or three pieces will not answer. The artificer, besides, acts as a matross, and if he were not with the caisson, it would be necessary to place another person there.

Six men, taken from among the gunners and matrosses, are raised to the rank of pointers, and have the same pay as the artificers and workmen. The pointing of the guns is of such importance, that no pains should be spared in instructing the pointers, and exciting emulation among them. It ought not to be given with any

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and should therefore be 3 sections of men or squads. It may be said, that the 4th squad will remain at the park to perform its service, and supply the place of casualties. I have seen so much service as to know that this is not the case ; a captain always divides his company in conformity to the number of pieces he is to serve, and if there are any supernumeraries, he does not send a whole squad to the reserved caissons, but the lame and the awkward, which is a better arrangement. Besides, why do not the partizans of a division into 4 squads to serve 6 pieces, divide their company into five when it is to serve 8.

* An artificer is an artillery soldier who prepares the fuses of shells, &c. makes quick matches, port fires, and all sorts of military fireworks ; his pay for this is high.

regard to date of service, nor to be claimed exclusively by the corporals, but to those that are best fitted for it; if the corporals are qualified for this function, they will exercise it as their right, but not else.

Let us now inquire into the organization of the Personal, as it is, or ought to be, in one of the great states of Europe; this will furnish us with data for calculating that of a state that has less need of a military force.

COMPOSITION OF A REGIMENT OF FOOT ARTILLERY.

A regiment of foot artillery should be composed of 3 or 4 battalions, according to the number of companies required for the service of its district; each battalion will consist of 6 companies.

The staff will consist of

1 Colonel.
1 Lieut. Colonel.
2 Majors to each battalion, (they command the artillery of a division in time of war.)
2 Adjutant Majors to the regiment.
2 Adjutants to each battalion, (they are needed with divisions of artillery in the field.)

*The minor staff consist of,**

1 Drum Major.
1 Master Artificer.
1 Master Armourer.

COMPOSITION OF A REGIMENT OF HORSE OR LIGHT ARTILLERY.

A regiment of horse artillery should be composed of six or eight companies at most, divided into squadrons of two companies each. (The horse artillery ought to be, from one fifth to one fourth of the whole force, that may be thought necessary in the field.)

The staff will consist of,

1 Colonel.
1 Lieutenant Colonel.

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* I do not mention the music nor the master workmen, (tailor, shoemaker, &c.)

1 Major to each squadron of two companies.
1 Adjutant Major.
1 Adjutant to each squadron.

The minor staff of,

1 Trumpet Major.
1 Master Artificer.
1 Veterinary Surgeon.
1 Master Saddler.

Each regiment of foot artillery should have one or more companies of invalids, who although not capable of service in the field, are adequate to garrison duty. It will not do, in time of war, to dismiss artillerists who may still be useful, and they are wanted in garrisons; let us, therefore, preserve all those old servants who are willing to stay; they are usually good pointers, expert in all the labours of defence, and capable of instructing recruits and militia artillery. In this case the invalids of the light artillery may be transferred to these companies.

Sea Fencible Artillery.

The service of the cannon of sea coast batteries, is performed in France by the *cannonniers gardes cotes*, a sort of militia. The officers are, for the most part, drawn from the land artillery and naval services, as are some of the non-commissioned officers and the artificers. The service of the forts upon the coast is performed by companies of veterans. There are, besides, moveable batteries. (See *Batteries and the Defence of Coasts.*)

The service of sea coast batteries is simple and not fatiguing; it is accidental, and therefore cannot conveniently be performed by the artillery of the line. The companies of it would be too much cut up, and as they would have only the least important of all their duties to perform, would lose their discipline, activity, and knowledge; the soldier kept in idleness would become dissipated; and to replace his lost discipline, would not have the zeal that a militia soldier would show in the defence of his property. Finally, at every peace it would become necessary to re-form the regiments employed in this service, which produces discontent, while the prospect of it is injurious to a corps. (*Gassendi*, 1155.)

OF THE DRIVERS, OR ARTILLERY TRAIN.

One of the principal requisites of good artillery is, that it should manœuvre well, and perform all its evolutions with rapidity and precision. In order to bring this about, it is necessary that the drivers who conduct the horses, both of the piece and the caissons, should know the manœuvres and words of command, and how to perform them. The firing of the piece is the duty of the matrosses, but its evolutions depend in a great degree upon the drivers; the necessity of having trained men for this service, is so fully admitted among the powers of Europe, that these drivers are organized in some nations into battalions, under the name of artillery train, while in others they form an integral part of the companies of artillery. If the men who drive the horses of the guns or caissons, do not know how to obey the word of command, the pieces will manœuvre slowly and badly, will lose time that is often precious, will become entangled one with the other, and in this state of confusion will be torn to pieces or overthrown by the enemy's artillery; thus causing disorder among those troops that are nearest them, if it do not extend farther.

When the drivers are an integral part of the company, they are usually better disciplined, and act with more uniformity; a battery thus driven, is more easily governed by its commander. This organization is only proper in states that have small armies, or that do not carry on war at a distance from their frontiers; but is attended with difficulty in nations that have numerous troops, and where there are great movements to be performed by the artillery. Still, however, I do not see such very great inconveniences as are alleged in making the drivers, even in the greatest states, an integral part of the artillery companies, in numbers sufficient for the pieces and other carriages of a field battery. In this way there would be an economy both in officers and non-commissioned officers; during war no more than an additional orderly sergeant to conduct the caissons of the batteries, and take care that proper attention was paid to the horses, and a second quarter master sergeant, to keep the accounts, would be needed. Battalions of train might then be provided for the parks of armies and sieges; as these battalions have not the same need of instruction as the drivers of the field batteries, they may be recruited at the break-

ing out of a war; and it will be sufficient to keep their skeletons on foot in time of peace.

If this plan, of drivers attached to the companies, be not adopted, the train ought at least to be improved in such a way, that its companies may not all be composed of similar proportions of good and bad drivers; from this it follows that the batteries are no better, or rather quite as ill driven, as the carriages of the parks; and how great a difference ought to exist between them in this respect? In order that the parks may have the worst soldiers of the train, and the batteries the best, I would propose the following plan, viz.

Let there be companies of *Elite*, in each battalion of the train, especially destined to the service of the batteries; these may be called battery-companies, and should be composed of the oldest soldiers, and most adroit drivers; they should be especially exercised to the manœuvres of batteries; and their ranks should be always kept, even in peace, upon such an establishment, as would secure at least one experienced driver to every carriage drawn by 4, and two to every carriage drawn by 6 horses.

COMPOSITION OF A COMPANY OF THE TRAIN.

A Field Battery of Foot Artillery, composed of 6 pieces, of which 4 are 12 pounders, and 2 howitzers, has in all 26 carriages. (This is the greatest number in any case.) If we calculate that the cannon are drawn by 6 horses each, and the forge and division waggon by the same number, the remaining carriages by 4 horses, a train of 137 draught horses will be needed to draw a battery of this caliber, and leave 15 spare horses. With the same number of horses a battery of horse artillery, that consists of no more than 20 carriages, may harness 6 horses to each of the caissons of the first line, and have 11 led horses. The Foot Artillery Battery of 6 pounders may carry with it 4 caissons of infantry cartridges, and have 19 led horses, or it may reinforce the teams of some of its pieces or caissons.

A Company of the train ought then to be composed in the following way, in order to conduct a field battery of any kind.

1 First Lieutenant, (to each company of *elite*, 2d Lieutenants to the others.

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1 Orderly Sergeant.
3 Sergeants. (1 to each section.)
3 Corporals. (It is not necessary to have as many as in the horse or foot artillery.)
1 Quarter Master Sergeant.
2 Trumpeters.
3 Smiths, (who are at the same time apprentice Veterinary surgeons; I say three, in order that the foot artillery may have one to each section.)
1 Harness maker.
80 Soldiers, of whom 24 are drivers of the first class.

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94 non-commissioned officers and soldiers, and 150 horses, of which 137 are for draught, and 13 for the saddle; 12 of the soldiers are not mounted, but kept in reserve to supply the places of the sick, wounded, &c.; the harness maker is not mounted.

There must be as many companies of *élite* as there are to be batteries in the field; teams and drivers, for the carriages of the great parks, in number about half the gross amount of the carriages of field batteries, (See *Field Equipage.*) for the equipage of bridges of boats, and siege artillery. (See the Composition of these Equipages, vol. 1st and 2d.) One half or one quarter of a company of train must be added for every place that is to be put in a state of siege, according to the number of cannon to be employed in its defence, and the strength of the fortifications.

COMPOSITION OF A BATTALION OF THE TRAIN.

The companies of the artillery train that are thought necessary in time of war, upon the above data, ought to be formed into battalions, that should, like the regiments of artillery, be placed in different sections of the frontier.

A battalion of the train should be composed of 12 companies, forming 2 half battalions of 6 companies each. I do not give it the name of a regiment, for it would then become necessary to provide

it with a greater number of superior officers. The chief would have a claim to be a Colonel, and the commandants of each half battalion to be Majors, this would be a useless multiplication of ranks. I am not of the opinion of some military men, who are for giving the command of the battalions of the train to superior officers of the artillery; they would not be so well commanded by them as by officers who had served in the line of this corps itself; besides, it is much better that the chief of a corps should rise from the line of it, it mortifies no one, every body is better pleased, and all goes well.

The Staff of a Battalion will be composed as follows, viz.

1 Major.
2 Captains commanding half battalions, (stationed with the parks in time of war.)
1 Lieut. Adjutant Major.
2 Sergeant Majors.

The Minor Staff will be composed of

1 Trumpet Major.
1 Veterinary Surgeon.
2 Assistant do.
1 Master Saddler and Harness Maker.

PEACE ESTABLISHMENT.

The above organization is fitted for a state of war; but as it is not necessary that all the men attached to a piece should be equally well drilled; and as it is sufficient to have 5 of those attached to its service well instructed, (or even 4:) each company of artillery may, in time of peace, be reduced at least two fifths, taking care to retain the non-commissioned officers, who are the soul of the company. This also is the case with the companies of the train, one old soldier is sufficient for each carriage drawn by 4 horses, and 2 for each carriage drawn by 6, in the companies of *elite*. The other companies may undergo a greater reduction, as we have already stated. As to the workmen who are employed in the arsenals, the reduction in their numbers depends upon the quantity of the ma-

terial that is to be prepared in time of peace, to be ready for a future war.*

COMPOSITION OF A COMPANY OF WORKMEN.

Each company of workmen, of the same strength as one of foot, or horse artillery, ought to have the following proportion of artisans of different trades; 17 wheelwrights, 33 blacksmiths, 6 joiners, 9 carpenters, 9 whitesmiths, 2 coopers, 2 turners, 3 nailmakers, 1 tinman. The workmen will be arranged into 3 classes, 23 in the first, of whom 3 are master workmen, 30 in the second, and the remainder apprentices. The non-commissioned officers ought to be of a different profession in each squad, and no one should be appointed master-workman of the first class, unless he is able to direct and lay out the work. If circumstances require that the workmen in the arsenals should be much augmented, each company might be increased to 144 men. (Many good officers say that is the best force these companies can be composed of, and the most advantageous for the performance of the work.) The different workmen would then be in the following proportions: 25, 57, 12, 19, 15, 5, 5, 5, 1, instead of the numbers given above. The company must then be divided into 5 squads.

ARMOURERS.

In France, there are companies of armourers, who, by means of one or more caisson-workshops, repair small arms, in the rear of armies. I believe that it is as good a plan, more simple, and more economical, to have several armourers in each company of workmen, to make the repairs necessary in the field, and to preserve the arms laid up in depots, in time of peace. They will work in the manufactories when not otherwise employed.

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* The horses are sold when peace is concluded, the harness is placed in the stores of the battalions of the train, who are entrusted with the care of it, unless it can be advantageously sold. Sometimes the horses are distributed among the country people; those who receive them pay nothing for them, but when war breaks out, are bound to furnish an equal number in readiness for service. Opinions are divided as to which is the best mode of disbanding the horses of the train.

The caisson workshop, is a collection of armourer's benches, furnished with vices, that can, when wanted, be drawn out of the caisson, and will form a shop, in which 16 armourers can work. Some of them even carry a small forge.

PONTONEERS.

The use of pontoneers is, to form bridges of boats, rafts, and other temporary means for the passage of armies. As nearly the same number of men are required to throw a bridge over a stream, as to serve a battery of artillery, the companies of pontoneers may be of the same force with those of foot artillery: one squad will be composed entirely of boatmen, the rest of shipwrights, who are, at other times, employed in the construction of military machines. The workmen of the artillery were long employed in this service, but, within a short time, a corps of pontoneers has been created in France, who are exercised upon the Rhine.

OF ARTILLERY STOREKEEPERS.

The storekeepers have charge of the magazines of the artillery, of the records of deposit and consumption: those of the first class rank as orderly sergeants; those of the second, as sergeants. One, or more of them, are stationed at each fortress, in proportion to its importance; and in field and siege parks.

There are also conductors of artillery, who have the care of convoys when upon the road, but they are only store keepers under another name; since they should, like them, be prepared to watch over the arrangement of the magazines, and provide for the preservation of the material; must keep registers of receipts and deliveries; and since the store keepers, as well as the conductors, are entrusted with the care of artillery convoys; multiplying names has always the effect of multiplying the number of persons employed. No more store keepers are wanted, except the following, general, principal, and of the first and second class. (See Field and Siege Equipage.)

Resident matrosses are entirely useless; they were formerly called *State Cannouniers*, and are no more than the servants of the storekeepers; but veteran workmen are valuable, to perform small repairs in places where there is no arsenal, and they may, besides, as well as the resident matrosses, assist the storekeeper in taking

care of the magazines. But in a great laboratory, these state workmen are very useful, or rather indispensable ; 4 of them are needed in each arsenal. The first, who commands the others, will attend to the examination of the rolls of the workmen, to the entry of their days' works, that should correspond with that of the orderly sergeants of their companies ; the second will measure wood in the rough, see it stowed away in the store-houses, and will issue it for use ; the third will take charge of the iron, and will, along with the store keeper, deliver it to the order of the officers who superintend the constructions ; the fourth will direct the workmen in wood, and inspect their workshops.

LOCATION OF THE PERSONAL.

It has been already said, that the frontiers of a state ought to be divided into great districts ; in each of which there ought to be one or two regiments of artillery, (sometimes one of foot and one of horse artillery,) according to its importance and situation ; also battalions of the train ; a great arsenal of construction, and sometimes a cannon foundery, and a powder mill. These great artillery garrisons are also called regimental schools ; they should be in strong towns, in order to place the arms, ammunition, cannon, and gun carriages, in safety, with every other sort of store, that must be prepared and kept in reserve, so that the nation may not be found unprovided on the breaking out of a war.

Besides an arsenal to every regimental school, there should be towards the centre of the country, that is to say, at the point that is the centre in a military point of view, a great arsenal of construction, or at least a great depot, of cannon, gun-carriages, ammunition, muskets, &c. as a last resource for arming the citizens, in case the other arsenals should be invaded.

This great interior depot, ought to be in rear of the capital, near the position to which the army would probably retire to continue the war, or procure an honourable peace. The country is next divided into inspection districts, which comprise the great military divisions of the country, and the artillery establishments of the interior, such as manufactories of small arms, powder mills, depots of artillery, &c.

OF ARSENALS.

Each great arsenal of construction ought to have one or more companies of workmen, in proportion to its importance, and the material it will be expected to furnish for field batteries, parks, whether of marching or besieging armies, and fortresses. The arsenal is directed by a colonel, who has a major under him as his assistant, several captains, or captain lieutenants, attached, (who are placed there, in time of peace, to acquire information,) and storekeepers, workmen, &c. Less important arsenals are commanded by majors. Those small posts where no manufactures are carried on, and where there are only depots of artillery, do not need artillery officers in time of peace ; a storekeeper is sufficient for the care of the magazines. If officers were posted in such places, they could learn nothing, and would forget what they had already acquired ; it is much better to keep them employed at the great arsenal, and send them, once or twice a year, to inspect the magazines and stores at the lesser posts, and make a detailed report of their state, to the director. In a single careful inspection of this sort, they will know more of the situation of the artillery than in a year or two of constant residence, without the opportunity of instruction.

OF REGIMENTAL INSTRUCTION.

In time of peace, no more gunners and matrosses ought to be left in fortresses and forts, than are absolutely necessary ; the others ought to be collected at the head quarters or regimental school of their district, to be instructed in the practice and the theory of their art. They ought to be exercised in serving and firing all sorts of cannon ; drilled to the manœuvres of batteries,*

* For this purpose, a regimental school has a *polygon* or place of exercise for cannon, with a butt against which the guns are fired. The ground ought to be of such a nature, that field guns may be fired at every possible distance from the butt, between 100 and 1000 yards. A front of a fortification is constructed, against which all the works of attack necessary for the instruction of the officers are carried on. There should also be a sufficient number of horses of the train, to harness at least six guns and six caissons, to drill the officers and soldiers to the manœuvres of field batteries.

&c.; taught to throw bridges of boats, construct rafts, &c.; to erect fortresses, besieging, and sea coast batteries; to prepare saucissons, gabions, all sorts of revetments, and military fireworks; to manufacture gunpowder.

The non-commissioned officers ought to have school-rooms where the theory of firing, the tracing of batteries, the elements of fortification, and the solution of the geometrical problems most necessary in the field, are taught them; and where they also learn the *school* of the battery and of the platoon.

The officers, besides the knowledge they ought to have acquired previously, will have halls of instruction in all the sciences necessary to an artillerist.

In France, the old plan is kept up, of having mathematical lectures several times a week, that are attended both by the officers who come from the military schools, and those who have never been there. This method of instruction is bad.

The object of a regimental artillery school ought to be, to apply their previously acquired knowledge, in mathematics, chemistry, and natural philosophy, to the science of the artillerist, and not waste the time of the officers, by compelling them to review, from year to year, the mere elements of those sciences that are no more than the bases of that they profess. The military and civil engineers of France, have constant use for the application of the physico-mathematical sciences, to their own profession; yet how happens it, that in these two corps, whose reputation is deservedly so high, there is no school to keep up the recollection of the elements? The reason is, that it is not necessary to have the elements constantly before the mind, but only to be able to recal them when they are to be applied. The application will renew the knowledge of them, and something new will be learned.

An artillery officer, to be well informed, should possess, besides the knowledge required in his immediate profession, precise ideas of military operations, combats, battles, and the attack of posts; he should be able to give his advice on the choice of military positions, to reconnoitre a fort, an intrenchment, a fortress, or a country; he should understand the elements of Fortification, and the principles of military construction, in order to have it in his power to superintend and improve the manufacture of all sorts of arms,

projectiles, carriages, machines, and utensils, that are used in Artillery; he should understand the manœuvres of Infantry and Cavalry; be able to repeat carefully all experiments having relation to his profession; and moreover he should not have lost the habit of thinking, and of reflecting upon questions already discussed. With this view of the subject, I propose the following course of theoretic instruction.

The method of drawing all the constructions of artillery; the application of chemical and mineralogical science to this art; the theory of firing and of manœuvres; the trace of batteries, of field fortification, and the description of the several parts of the fortification of a strong place; meetings of officers, at which the chief of the school should preside, to reason upon their profession, and to ascertain the knowledge of the officers in the service of their arm; military excursions on foot, in which the commandant examines the officers on the ground, upon the location of batteries, the attack and defence of positions, &c.*

The officers will draw up memoirs, that are to be read and discussed in presence of all the officers; upon the form and dimensions of cannon, projectiles, gun-carriages, waggons, &c.; upon the different attempts that have been made to improve them; upon the composition of military fireworks; upon iron, forges, and founderies; upon projects for barracks, for magazines, for firework laboratories, for arsenals; upon the proper plan for the defence of a country; on the service of artillery in the attack and defence of places; on projects for the equipage of field, siege, and garrison artillery; on the implements of every species of artillery; on military reconnoitring and castrametation. It appears to me that these questions, and a multitude of others that might be proposed, would present to the officers a subject of study extremely instructive, as it would require them to read a number of works, all having relation, in some degree, to the science of an artillerist. Military authors, books treating of the exact sciences, of arts and manufactures,

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* In France, each regimental school is commanded by a general officer of Artillery, who has the command and inspection of all the artillery; in time of war, he is employed either to command the artillery of a wing of an army, or at a siege, a bridge equipage, a great park, &c.

would be consulted in their turn, and the perusal of them cannot fail to produce a happy result.

As to officers who have never passed through the elementary schools, I am convinced that to attempt to teach them mathematics is to waste their time.* It is enough to give them clear ideas of the Principles of the Construction of the Material, and of the Service of Batteries in the field.

OF PROMOTION.

To create emulation, and in order that the progress of a studious officer, who promises well, may not be retarded by those who patiently await their promotion from seniority; I should propose that one fourth of the vacant commissions of first lieutenant, captain lieutenant, captain, and major, should be competed for; that is to say, that out of four places that might become vacant in each of these grades, one should be given to him who shall appear, upon examination, to understand the several parts of the service of artillery best: he ought, however, to have served at least three years in the next lower rank, before he is admitted to the competition; and where merit is equal, the preference must be given to him who is the best soldier, and understands most thoroughly the mode of governing his men.

CENTRAL BOARD OF ARTILLERY.

"This board, that is intended to hasten the progress of the art of artillery, should be the centre to which all new discoveries, whether theoretical or practical, true or pretended, are referred; there they will be sifted, examined by reasoning, or submitted to proof: from thence, if approved, they will be transmitted for the instruction of the corps. Those whose duty it is to inspect the artillery, will collect these discoveries, and refer them to this board; but it will require strong and active minds, to perform this examination, and to disseminate the inventions." (*Gassendi.*)

This committee ought to be composed of superior officers, among whom, should be one or two who have commanded workmen,

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* Each regimental school should have a Professor of Mathematics, who should possess a knowledge of Chemistry, and a Teacher of Drawing, who is acquainted with Fortification.

and at least one who has served during war with field batteries, and understands the manœuvres, and the service in general, of artillery in the field. Those who have made use of artillery in actual service, are best qualified to judge what improvements ought to be made, and what innovations rejected. I will add, that this board should keep itself informed of all the new discoveries made in artillery among foreign nations; it ought also to transmit every year to each colonel commanding a regiment, to all directors of arsenals, inspectors of forges, manufactories of arms, powder mills, and founderies, an account of the discoveries made, and alterations proposed, in order that the officers under their command may be acquainted with them, and have an opportunity of making their observations upon them.

In France, this committee is composed of three generals, two colonels, and two majors. All the inspector generals are invited to attend its meetings, and give their opinion, but without a vote; for in Paris they would form a majority, and might, by a combination among themselves, carry opinions that could not be those of the board, the members of which are alone responsible.

SOME IDEAS UPON THE ORGANIZATION OF THE AMERICAN ARTILLERY.

The organization of a corps of artillery must undergo modifications in a country like the United States of America, that does not contemplate carrying on a war at a distance from its frontiers, that is surrounded only by colonies, and whose natural defence is a militia force. The small regular force this country maintains in time of peace, ought to consist, for the most part, of artillery. To this some will say, that I am an artillerist, and think of nothing but artillery. I must, therefore, explain myself. I consider that 3000 men upon the peace establishment are necessary to form an artillery that would be effective in time of war; now, the regular army is only about three times that number; it must, therefore, be stronger, in proportion, in artillery than in infantry. Many years of assiduous attention are necessary to form a good artillerist, and at the beginning of a war the American armies, consisting almost entirely of militia, will be ill disciplined, and will require more artillery, to make up for their want of skill in manœuvring; to support them; to keep the enemy in check; to prevent his sudden approach, and his taking advantage of his superior dexterity.

I would, as before, form every company of foot artillery of 4 officers and 82 matrosses, and add 58 drivers, who will raise it to 140 men. This company will be able to man and manœuvre a battery of 12 or 6 pounders, and if the last, may have 3 or 4 caissons for infantry cartridges. (It must be provided with them in all cases, for the artillery supply the infantry with cartridges.)

The company of horse artillery should consist of 4 officers, 94 matrosses, and 56 drivers, which will make its complement 150; every piece, and the caissons of the first line, must be drawn by 6 horses. (Two caissons to each piece are, in this case, sufficient.)

One hundred and twenty pieces of cannon, well served, and drawn by good horses, seem to me to be adequate to the wants of any regular armies the United States will ever wish to bring into the field. These may be formed into five great divisions, of which four are of 4 batteries of foot artillery each, or 96 pieces in all; and one of 4 batteries of light artillery, making 24 pieces. Twen-

ty companies will be required to serve them; and if we suppose that the guns of fortresses will need 2200 matrosses or 16 companies* more, this will be in all 36 companies of artillery. I should propose that these should be organized into four regiments of foot artillery, composed of two battalions of four companies each; and one of light or horse artillery of two squadrons, each of which consists of two companies. My reason for this is, that I consider that the United States have five great and distinct portions of frontier to guard.

THE FORCE OF A REGIMENT OF FOOT ARTILLERY ON THE FULL WAR ESTABLISHMENT WILL BE,

Staff.	*Minor Staff.*
1 Colonel.	1 Drum Major.
2 Majors.	1 Master Artificer.
1 Adjutant Major.	1 Master Armourer.
2 Sergeant Majors.	1 Master Wheelwright. †
—	1 Master Smith. †
6 Officers.	—
	5

Eight companies, each of 4 officers and 140 men, will, with this staff, form a total of 38 officers and 1125 non-commissioned officers and soldiers.

THE FORCE OF A REGIMENT OF HORSE ARTILLERY WILL BE

Staff.	*Minor Staff.*
1 Lieut. Colonel, (or Colonel.)	1 Trumpet Major.
2 Majors.	1 Master Artificer.
1 Adjutant Major.	1 Veterinary Surgeon.
2 Sergeant Majors.	1 Master Saddler.
—	1 Master Wheelwright.
6 Officers.	1 Master Smith.
	—
	6 non-commissioned officers.

* Five men are reckoned to each garrison gun, but they may be served by four; besides, the pieces seldom fire all at once, so that the men may assist one another, and in many cases no more than three men are allowed to each gun.

† These head workmen will direct the workmen of the companies of non-commissioned officers when they are employed in the regimental arsenal.

Four companies, of four officers and 150 men, make, with these, a total of 22 officers and 606 non-commissioned officers and soldiers.

The whole force of the artillery in time of war, and when the ranks are full, would then be 174 officers and 5,106 non-commissioned officers and matrosses. But it is not necessary, as has already been observed, that all the men that serve the pieces should be equally well drilled; if half the number in the field are old soldiers, it is enough; on this account, the company of foot artillery in time of peace, need not be more than 75 men, or of horse artillery than 80; this will reduce each of the regiments of foot artillery to 605 non-commissioned officers and soldiers, and the regiment of horse artillery to 326. The whole force of the Artillery will not then be more upon the peace establishment than 2,746 men; this reduction will be an economy both of men and money, and will not interfere with the efficacy of the arm in time of war, if those retained in the service are well disciplined. There need not be more than half the number of Captain Lieutenants, but I would retain all the non-commissioned officers, because they should be all well instructed; in which case they are the soul of the company.

A Colonel, a Major, and one or two companies of workmen, ought to be added for the service of the central arsenal.

The artillery need not be put upon the full war establishment, unless the United States were attacked upon all their vulnerable points at one and the same time. In this case it would be very advantageous to have good artillerists, and a well placed material; upon the plan I have given, a still greater number of batteries, served by well drilled men, might be brought into the field, by drawing the companies from the forts they garrison, and replacing them in whole or in part by militia.

As regards the location of the regiments; the formation of the great depots and small workshops for the repair of moveable batteries, the material, &c.; the proper position of the central arsenal, I do not think it is within my province to speak of them.

I shall content myself with observing, that as the countries which border upon the United States are all European colonies, and draw their ammunition from the mother country, it will, therefore, be advantageous to the Americans to have calibers that differ from those of their neighbours, in order that they may not make use of

the ammunition, even if they become masters of it. This might produce happy effects at a time when the enemy's ammunition is expended. For this purpose all that will be necessary is, to augment the caliber of the American pieces so much, that the ball may be of the same diameter with the bore of the English gun of the same denomination. The projectiles of the Americans, then, will not answer the guns of the English, while, on the contrary, theirs may, in case of need, be employed by the Americans. As to the Spaniards, they have the old French calibers, 4, 8, and 12 pounders, and 6 inch howitzers.

I shall conclude this chapter on the personal, by replying to an observation I have heard made, that horse artillery is of no use in a woody country like the United States. I might content myself with saying, that I have already seen fields of battle as extensive as any in Europe, and where horse artillery would be of the greatest service. But I shall prove the utility of this arm more conclusively.

Horse artillery is not intended to charge in line, nor is its service limited to great tactical movements upon vast plains; no more space is occupied by a battery of horse than by one of foot artillery, nor does it need more room to display; it has no more occasion to charge than the latter, and, like it, acts by its cannon alone. The matrosses are mounted only for the purposes of moving as fast as the guns, when it is wished to carry them rapidly to some particular point; of arriving fresh and ready to manœuvre, which foot artillery would not; of falling unexpectedly upon a body of men and destroying it; of reinforcing part of the line that is either to be carried forward, or is likely to give way. To maintain that foot artillery can do the duty of that which is mounted, is to assert that infantry can move as rapidly as cavalry, and arrive as little fatigued, and in as fit a state for action. Fewer horse artillery will be needed in a woody, than in an open country, but it is still wanted even there for all movements that require to be promptly executed. Batteries of horse artillery, organized as I have described above, the horses of the matrosses equipped with a breast collar, and traces concealed under the housings, by which they may, in case of need, be harnessed to the pieces, will never be left behind, and will be of the utmost value to the commander of an army, who can always depend upon having them at his disposal.

ART OF FIRING CANNON.

The art of firing cannon consists in being able to direct a projectile, so as to strike the mark. Its theory depends upon the action of gravity, and the force with which the projectile is driven from the gun by the inflammation of the powder.

Let us suppose that a body is projected in the direction *a c*, from the point *a*. (pl. 7. fig. 1.) This body would describe the straight line *a c*, if it did not gravitate; but the action of gravity, that does not for an instant cease to influence it, causes it to deviate continually from this direction, and in the time that it would otherwise have described the space *a d*, brings it down a certain distance *d o*, the quantity of which depends upon the time in which *a d* is passed through. The greater the charge, or the stronger the powder, the longer will be the curve described by projectiles from the same piece; the line of sight will then intersect it farther from the piece, and the point blank be consequently more distant. The quality of the powder has therefore an influence on the fire.

Since the projectile has a constant tendency to fall, from the moment it leaves the muzzle, and to quit its first direction which is in the axis of the piece, thus describing a curve; it is very important to know what the curve that the projectile describes is, and what is its relation to the line of sight.

The line of sight *m r*, (fig. 1.) is the visual ray directed through the highest points of the breach and the swell of the muzzle, and terminating at the mark.

The curb *a o p*, that the projectile describes in its course, is called the trajectory or line of fire, (it is called the curve of pro-

jection.) Because the diameter of a gun is greater at the breech than at the muzzle, it is evident that the line of sight will cut the line of fire at least once, if gravity did not act, but in consequence of it they intersect each other twice: the first time in the point *i*, that is near the mouth of the piece; and the second time in the point *b* at a considerable distance, that is called the *Point Blank*.* When the projectile leaves the piece, it is at first below the line of sight, which it cuts in *i*, (nearly where the line of sight cuts the prolongation of the piece; this point is 24 feet from the muzzle of the French 12 pounder:) it then describes a portion of its trajectory above the line of sight, until, by the force of gravity, it crosses it again at *b*, and passes below it never again to meet it: if then the mark were between these two intersections *i* and *b*, it would be necessary to aim beneath it, in order to strike it; and if it were beyond the second intersection *b*, it would be necessary to aim above it.† Thus, in order to take aim, the distance the projectile is above or below the line of fire in every part of its flight must be known. These quantities ought to be calculated, and inserted in the tables of fire for each sort of ordnance; it is also necessary to know how to estimate the distance between the piece and the mark, in order to apply the division of the moveable sight or *hausse*, that is proportioned to it. (we shall see presently that the divisions of the sight correspond to the quantity the piece is to be elevated;) it is also evident that the force of the gun-

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* The term Point Blank has a very different meaning among the British Artillery; they suppose the piece to be mounted on its wheels and placed upon a horizontal plane, the bore of the piece also horizontal; if it be fired in this position, the point blank distance is that between the muzzle of the gun and the point where the trajectory of the projectile crosses the horizontal place on which the wheels rest. It is needless to say, that the French meaning of the term is that which is used throughout this work; it is well understood by all American military men, and is much more easily applicable to practice in the field than the English. Tr.

† If the mark is in either of the two intersections, the aim must be direct in order to hit it. There are then two points that may be called *Point Blank*, for that is the point the gun ought to strike if aimed directly against it, by the primitive or natural line of sight, but the first intersection being so very near the mouth, is not thonght of in firing. It is to the second alone that the name of point blank is given.

powder must be known in order to make the aim certain, because the quantity the ball is at any time above or below the line will vary with the force.

The inspection of fig. 2. shows, that if the mark is beyond the natural point blank, at *f* for instance; it cannot be aimed at by the visual ray *m r*, directed along the piece, which must be pointed above the object; in this case the fire would be uncertain, since there would be no fixed point to which to direct the line of sight; it therefore becomes necessary to raise the line of sight at the breech to the height *h*, in order that its other extremity may pass through the mark. The quantity *h m*, that the line of sight is raised at the breech, is called the elevation, and the point *f* to which the projectile is thrown is called the artificial point blank; the other is the natural or primitive point blank. A moveable sight (*hausse*) is adapted to the breech of the gun, by means of which the angle, formed by the intersection of its axis, and the line of sight, may be increased as far as convenient, and the point blank may be thus removed to the distance at which the object to be battered is situated; in this way the gun may always be fired point blank or pointed directly at the object, it is only necessary to know how to estimate distances by the *coup d'œil*, in order to fix the moveable sight at the corresponding elevation.* I suppose that the object is 1000 yards distant, (let *f* be this object,) I am obliged to augment the angle the piece makes with the horizon,† or to elevate the piece in order to obtain this range; if this were not done, the ball would, in consequence of its gravity, fall to the ground at *p*, before it reached that distance, as is shown in fig. 1. The elevation *m h* that must be given to the moveable sight in order

* In the second volume, when treating of the attack of places, the translator has distinguished between those fires in which the piece is directed straight to the object, either by means of the moveable sight or the primitive line of sight, and those where it is elevated in such a way as to produce the ricochet; calling the one, point blank, the other ricochet, fires. Tr.

† This angle that the axis of the piece makes with the horizon, is called the angle of projection. The amplitude, or horizontal range, is the distance to which the projectile is thrown upon the horizontal plane that passes through the point of projection from whence it is fired, and which is called point of departure or battery; the place where the projectile strikes the ground is called the point of fall.

to strike the object *f*, is that which will answer for all other objects the bullet is to strike at a distance of 1000 yards.

Hence we see that a gun, whose diameter at the breech is greater than another of the same caliber, will have a more distant point blank, because its line of sight makes a greater angle with the axis of the piece. Thus the dimensions of the gun that affect the fire are, the diameter of the base ring, and of the swell of the muzzle, and the distance between them.

The POINT BLANK (*but en blanc*) is then the point where the line of fire cuts the primitive line of sight, the second time. The distance between the guns, and this point, is called the point blank range. This distance is a little greater when the axis of the gun is depressed below the horizon, and a little less when it is elevated above it; but these differences of range are trifling when compared with those given when the axis is horizontal, and may be neglected in practice, without any sensible error.

The Artificial Point Blank is that which is produced by means of the Hausse, or the Gunner's Quadrant.

It must be observed, that the same gun has not a constant point blank, with the same charge of powder; it will vary with the strength of the powder, the widening of the vent, the shape and diameter of the ball, and the mode of loading; the elevation of the moveable sight diminishes, as the force of the powder increases.

Sometimes a piece has faults in its bore, that cause the ball to strike against its sides, and give it a direction either above or below the true one; this will alter the point blank distance a little, and cause an alteration in the distances shown by the divisions of the moveable sight. There are some guns, whose projectiles deviate as much as 15 degrees, and this deviation is sometimes in a trajectory of double curvature; that is to say, after having deviated to the right of the axis of the piece, the same ball will cross it, and deviate to the left.

The pointer ought to study his piece, and for this reason the men who serve a piece must never be changed in the field; while in the school of application each pointer must leave his piece as soon as he is well acquainted with it, and proceed to study another.

Of the Moveable Sight.

The *Hausse*, or moveable sight, is a rod of copper, fitted to the breech, that is raised and lowered in a groove made for the purpose, and is fixed by a small tangent screw. It is divided into quantities corresponding to ranges of one hundred yards. In order to obtain an artificial line of sight, that will reach any particular object, the hausse is fixed at the division that marks its distance. The mode of dividing the moveable sight into parts of an inch only, is bad, for as the memory cannot retain the number of lines that the sight must be moved for each particular distance, the pointer must always have a table in his hand. The limb of the sight must be divided into two columns, having relation to different strengths of powder; one for powder of ordinary strength, the other for the strongest that is ever met with in the service; on each column, divisions are marked, showing the distance corresponding to them with each sort of powder, and the officer who must know the strength of what he uses, will easily know what elevation is to be given.

Battering and garrison guns have no moveable sight. When the pointer has discovered the elevation that suits the point he is to batter, he can always give the piece the same by means of a ruler placed between the handle of the elevating screw, and the pointing plate. Moveable sights of wood are sometimes provided for these batteries; they are held upon the breech when the gun is aimed. A small quadrant of brass is sometimes used instead of the Hausse. In that case, the elevation is reckoned in degrees, and not in parts of an inch.

Initial Velocity.

The initial velocity of a projectile, is that which it has when it leaves the mouth of the piece.* At this time, the expansive force of the powder, that acts upon it as long as it is in the bore of the piece, ceases to influence it, and leaves it to pursue its course with the velocity it has previously acquired. The initial velocity is

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* In speaking of velocities, it is always to be understood, that the unit of time is a second; thus, when we speak of the velocity a bullet ought to have, to produce any particular effect, 1,300 feet for example, it is to be understood that the projectile passes through 1,300 feet in a second of time.

then augmented, both by the force of the charge of powder, and the length of the bore; but not beyond a certain limit. The powder acts upon the projectile as far as that point in the bore where the force of the elastic fluid is in equilibrio with the pressure of the atmosphere; if this point is at the muzzle of the piece, the initial velocity will be a maximum; if the bore be shorter than this, the initial velocity will not have arrived at its height; and if the length of the bore extends beyond this point, the velocity will be again diminished by the pressure of the atmosphere, that will then exceed the force of the elastic fluid generated by the gunpowder.

The charge that produces the greatest velocity is different in every different piece. The part of the bore that is filled with the charge ought to be in a reciprocal ratio to that which extends from the charge to the mouth of the piece. In the 24 pounder, that has a bore 20 calibers in length, the depth of the charge, to produce the greatest velocity, ought to be $\frac{1}{3}$ of the length of the bore; this will contain 28 pounds of powder, or a little more than the weight of the ball; in field pieces, it is about equal to the weight of the ball.

The ranges augment in a much less ratio than the velocities, and about in proportion to their square roots, the piece and the angle of projection being the same. The initial velocities given by equal charges of powder, of unequal strengths, are to each other as the square roots of the range of the eprouvette mortar.

OF THE DIFFERENT MODES OF FIRING.

There are four modes of firing guns: at random; point blank; *à plein fouet* or direct; and ricochet.

Guns are said to be fired at random when they are loaded with the largest regulation charge, and pointed at the greatest elevation their carriage will permit; this mode of firing is rarely employed.

Cannon are said to be fired point blank, or to the primitive point blank, when the mark is exactly in the spot where the line of fire cuts the primitive line of sight the second time; the piece being loaded with the greatest regulation charge.

A gun is said to be fired direct, (*à plein fouet,*) when the bullet strikes the object without bounding or *ricochets.*

A ricochet fire is when the ball strikes the ground short of the mark, and then reaches it by bounding.

Of Taking Aim.

In order to take a sure aim, it is necessary, 1st. That the distance between the piece and the mark be correctly estimated, and the strength of the powder known.

2d. That the pointer shall take sight along the uppermost points of the base ring and the swell of the muzzle, without regard to the sights that are cut into them; in this way the line of sight will be perpendicularly over the axis of the piece, and in the plane of the motion of the ball, as it ought to be; for it may happen that one of the trunnions is inclined, to the right, for instance, in which case the line passing through the marks upon the breach and the swell of the muzzle, would no longer be the true line of sight, and if it were used to aim by, the ball would deviate to the right.

Note. I agree with General Gassendi in the improvements he proposes, viz. to file the left trunnion plate of the gun-carriage smooth, and make it fit the trunnion exactly; to draw upon the face of this trunnion, a horizontal diameter, with a vertical semidiameter beneath it; one of the quadrants formed by these two lines must be divided into degrees. The piece being placed with its carriage upon a horizontal plane, the point of the trunnion plate, opposite to the vertical semidiameter drawn upon the trunnion, must be marked with a notch. By these means it may easily be seen at what elevation the piece fires when it is levelled at its primitive point blank; the equalities and variations of aim may be verified; and even distances estimated with greater facility.

Of the Ricochet.

The art of firing the ricochet consists in giving the projectile a force sufficient to carry it to a particular point, whence it continues its course by bounding along the ground. (Fig. 3. pl. 7.) The causes that principally act upon this sort of fire are, the angle of projection, the resistance and elasticity of the reflecting plane, the initial velocity of the projectile, and its form and weight.

In making use of this sort of fire, the projectile ought to fall upon the ground at the most acute angle possible, not only that it

may not bury itself, but that when it rises again it may describe a new course, that in no place passes above the objects that are to be hit. The smaller the angle of fall is, the lower and more numerous are the ricochets, and the more probabilities exist of striking objects that are on the ground. In order to use the ricochet to advantage, the angle of projection should not exceed eight or nine degrees, but howitzers may be used for this purpose at much greater angles.

It is necessary to be at a great distance, to use the balls of common field pieces, as ricochets, against troops in column or behind epaulments, when the charge is that of the regulation for ordinary service; but a howitz has a much less initial velocity; this is better suited to the ricochet, enables it to be executed at a shorter distance, and, consequently, with more accuracy.

Upon dry and level ground, a projectile bounds well, but upon soft ground it buries itself, and does not ricochet.

When it is wished to enfilade a branch of a *permanent work* with the ricochet, it is necessary that the projectile shall be in the descending branch of its trajectory, when it passes over the parapet, so that, by falling continually from *c* towards *h*, (fig. 3.) no object on the rampart can escape it, and as it strikes the earth at a very acute angle, its new trajectory will be a flattened curve. For this purpose the charge and the angle of projection must be regulated by the height of the rampart and its distance from the battery. For instance, if a French 24 pounder is to fire ricochets into a rampart raised 30 feet above the platform of the battery, and distant 600 yards, the charge must be $2\frac{1}{2}$ lbs. of powder, and the elevation of the hausse 4 inches; while at a distance of 400 yards only 2 pounds of powder must be put in, and the sight raised $2\frac{3}{4}$ inches; at equal distances, if the velocity be diminished, the elevation must be increased.

When a direct fire is made against a lofty object, and the ricochet is to begin immediately beyond it; the initial velocity must be small, or else the projectiles, after passing the mark, would be still in the ascending branch of their trajectory.

Experiment has proved that 24 pound balls, fired at an elevation of 8 degrees, have made 9 bounds upon ground nearly on a level with the battery.

Dupuget says, that in order to reach ground much elevated

above the platform of the battery, it is best to retire to the distance of 1200 yards, and fire with the service charge at an elevation of 13 or 14 degrees. But it is, in my opinion, better to employ small charges so as to make the projectiles perform the greatest number of bounds, retaining force enough to destroy gun-carriages and men, than to fire with large charges, for the projectiles then do not strike the terraplain as far from the parapet at the first graze, make lower curves, and leap to a less height, from one interval to another, over the traverses; they, besides, do most harm to the gun-carriages and guns.

Art of Firing Mortars.

The fire of guns, and even of howitzers, is in a flattened curve, but a shell in its course describes a lofty trajectory, the summit of which is sometimes elevated as much as 1600 yards, or even more.

Let *a h c* (fig. 4.) be the curve described by a shell in the air, *h* being its apex; the motion of the shell in the portion *a h*, or ascending branch of the curve is more rapid than in the descending branch *h c;* and the latter is more bent towards the perpendicular, and its base, consequently, less than that of the other.

For instance, a 12 inch shell, of the weight of 180 pounds, thrown at an angle of 45 degrees, with an initial velocity of 924 feet, will have a horizontal range of 14,175 feet; of which 8,023 is the part of the horizontal amplitude that answers to the ascending branch; and 6,152 that portion of the amplitude that is below the descending portion. The time that it will take it to describe the first, as far as the apex of the curve, will be 16 seconds and 8 tenths, and the time in the descending branch 18 seconds and 8 tenths; the greatest height of the trajectory will be 4,630 feet. "*Lombard.*"

There are two methods of Firing Mortars, first to have them constantly fixed at the angle of greatest amplitude, and to produce the increase or diminution of the range by the greater or less strength of the charge; 2d. By loading always with the same charge, but varying the degrees of inclination. In the first way, where the angle is always the same, and the charges increased or diminished, there are fewer deviations in the range; but it is often difficult to change the charge in a battery; it is therefore

preferable to vary the elevation; this cannot be done in mortars whose beds are cast with them, and is one of the reasons for not using them.

The angle of greatest amplitude is between 43 and 45 degrees.

Shells may be fired horizontally or as ricochets, by giving them a proper angle of projection.

A great cause of irregularity that always exists in the mortar, is the windage of the shell. Let us even suppose that the shell is placed exactly in the centre of the bore of the mortar, it may still deviate from the direction of the axis, a distance equal to half the windage. If the deviation takes place in a horizontal direction, the shell will fall to the right or left of the true aim; if, as happens more frequently, the deviation takes place in the vertical direction, a difference will arise in the length of range, (this last error is not so sensible as the former.) The deviation will be still more considerable, if the shell strikes the sides of the bore.

Observation.

We know that sound passes over 369 yards, (173 toises,) in a second of time, and may thence, with a good stop watch, calculate the distance of a battery of cannon by multiplying the number of seconds that elapses, from the moment the inflammation of the powder is seen to that when the report is heard, by 369. The product will then be the distance in yards.

Fire of the Musket.

The fire of the musket is governed by the same laws, and executed in the same way, as the fire of cannon. Its ball tends, in like manner, from the moment it leaves the bore, to fall by the force of gravity, and deviate from its primitive direction, which is that of the axis of the piece. In order to strike the object, it is therefore necessary to aim either above or below it in proportion to its distance compared with the natural direction of the line of sight.

As we here treat of the fire of the common musket only, it is to be remarked that the thickness of the barrel at the mouth is, by means of the sight, made equal to what it is at the breech; and that thus the line of sight is parallel to the axis of the piece, consequently there is no point blank, because the line of fire never

cuts the line of sight, as it does in pieces of cannon :* it is, therefore, always necessary to aim above the mark. The soldiers must be habituated to know the elevation that suits each particular distance, and learn to apply it in practice.

In order to strike an enemy in the stomach ; the aim must be taken at the middle of his body, at all distances less than 100 yards ; at the shoulders, at distances between 100 and 140 yards ; at the head from 140 to 200 yards ; and from 1 to 3 feet above the head, between 200 and 250 yards.

The line of sight being horizontal, and raised 5 feet above the ground, the bullet will strike it at the distance of about 320 yards ; but the effective range of the infantry musket is not more than 250 yards ; beyond that distance, the fire is uncertain, and is most formidable at 150 yards.

At an elevation of 43 degrees, its range is at least 1,100 yards ; and it will wound even at that distance.

OF SPIKING CANNON.

MODES OF SPIKING PIECES OF ARTILLERY.

The most ready, and most effective mode of spiking a gun, is to make use of a six sided spike, of a diameter proportioned to the vent of the gun, and tapering towards the top, that is a little larger than the vent. It is from 4 to 6 inches in length, in proportion to the caliber. The edges are cut in a direction oblique to the axis, into a number of teeth, the points of which are turned against the direction in which the spike is driven. It ought to be made of good steel, well tempered. The teeth that are formed on its edges, oppose its being drawn. As such spikes cannot always be had, a square nail may be used, a little longer than half the diameter of the piece at the vent. and its thickness at the mid-

* If the musket had no sight, and if the line of sight were directed along the barrel, then the line of fire would cut the line of sight at a distance of more than 150 yards; and if the thickness of the muzzle were augmented by that of the handle of the bayonet, the point blank would be distant 130 yards. In the first case, the greatest quantity that it would be necessary to aim below the mark, would be 10 inches, and in the second only 5.

dle, twice as great as the diameter of the touch hole. To spike a 24 pounder, for instance, a square nail may be used, 8 inches long, $\frac{1}{4}$ of an inch square in the middle, and $\frac{1}{2}$ an inch at the head; such a nail is driven in an instant. Spiking may also be performed with a nail, cut into the form of a screw, and tempered every where, except at the point, which is left soft, so as to be riveted; but two hours are required for this operation.

In order to augment the difficulty of restoring spiked guns to service, earth may be rammed into them, or a cylinder of hard wood placed at the bottom of the bore, and over it a ball of the caliber, wrapped in felt, and driven forcibly in. A ball wrapped in felt, is one of the most powerful obstacles that can be presented; but it is not altogether invincible. The method of raising up the piece, and throwing in burning charcoal to consume the felt, is not sufficient; for felt burns with difficulty, and does not remain inflamed, while the coals are extinguished for want of air.

In order to destroy a piece, it has been proposed to fire another against its chace, with the muzzle nearly touching it; this method does not always succeed, for a ball has been known to pierce the chace of a gun, without rendering it unfit for service, as the gash it cut had not pierced to the bore; besides, this method is too long in a sortie, and takes much more time than spiking. As for the plan of breaking off a trunnion, it is impracticable in large guns.

It is said that a brass gun may be rendered totally unfit for service by heating it in the middle, while the piece rests upon its two ends; the tin of the gun metal melts at a low heat, and the piece bends.

Of taking out Spikes from Guns.

The spike may be removed from the piece in the second case by putting in a charge of powder of about one third of the weight of the ball, ($10\frac{1}{2}$ pounds for instance into a 24 pounder;) a wad well rammed down and mixed with powder and quick match, is put over it, then one or two balls, or a cylinder of wood with a similar wad still more forcibly rammed. Fire is set to it from the chase. Several discharges of this sort must sometimes be made before the spike is disengaged.

Attention must be paid in putting down wads mixed with

powder, in order to fire the piece from the muzzle and force out the spike, that the fire does not communicate at once to the charge. This risk renders the operation a dangerous one. It is better to make use of a lath, a few lines square, of the same length as the bore of the piece, having a groove cut in it from one end to the other; into this is put a quick match that is fastened at one end and hangs out several feet at the other. The end of the lath to which the quick match is fastened, is introduced into the gun, and the groove is laid against the side of the bore; the piece is then filled with wads, made of junk, well rammed with a handspike. If a cylinder of wood is used, a groove must be made in it, through which a quick match is also passed. When the spike, in a brass gun, resists the explosion of the charge, the brass must be grated off round the end of the spike, and the cavity filled with aqua fortis, which is left some hours to produce its effect; the gun is then again fired, as we have directed. Spikes seldom resist this process.

When the spikes are toothed, or cut into screws, it becomes necessary to bore a new touch-hole by the side of the first. In order to perform this operation, it is known, that in a 24 pounder the touch-hole must begin at the distance of 4 inches 6½ lines from the edge of the base ring, and enter the bore one fourth of an inch from the bottom in the rounding of the angle; about an hour is needed to drill an inch in length; and there must be several drills of different lengths, in order that they may not wear out.

When the touch-hole is freed, or drilled anew, the obstacles in the interior may be easily blown out by powder introduced into the bore through it. (*Gassendi.*)

Note. If an iron gun has been spiked with a steel nail, the temper may be taken out of the latter by laying it with the vent down upon a bed of coals; the spike may afterwards be drilled out as easily as the touch-hole was at first. This process is used at the West Point Foundery. Tr.

TABLES FOR FIRING.

Of the following tables, the three first are those of English pieces; the others are calculated for French guns of the old regulation, several of which are in use in this country. When I give a plan of new field pieces, in the third part of this work, I shall accompany it with tables for firing them.

TABLE OF FIRST GRAZE WITH FIELD GUNS.*

	12 pr. 9 pr. and long 6 pr.	light 6 pounder.	light 5 1-2 inch howitzer.	
Elevation.	first graze.	first graze.	elevation.	first graze.
P B	300 yds	200	o	o
$\frac{1}{4}$ deg.	400	300	1 deg.	300 yds
$\frac{1}{2}$	500	400	2	450
$\frac{3}{4}$	600	500	3	600
1	700	600	4	750
$1\frac{1}{4}$	775	650	5	850
$1\frac{1}{2}$	850	700	6	950
$1\frac{3}{4}$	925	750	7	1050
2	1000	800	8	1150
$2\frac{1}{4}$	1050	850	9	1200
$2\frac{1}{2}$	1100	900	10	1250
$2\frac{3}{4}$	1150	950	11	1300
3	1200	1000	12	1350

* Twelve pounders, 9 pounders, and heavy six pounders, with a charge of one third the weight of the ball.

The light 6 pounder charged with 1 pound 8 oz. of powder.

Light 5 1-2 inch howitzer charged with 1 pound.

TABLE OF THE FIRST GRAZE OF ENGLISH BATTERING GUNS.

	Twenty-four pounder.		Eighteen pounder.	
	Elevation.	range.	elevation.	range.
Charge 8 lbs. of powder in the 24 pounder, and 6 lbs. in the 18 pounder.	0	297 yds	0°	385 yds
	1°	720	1°	881
	2°	1000	2°	1060
	3°	1240	3°	1340
	4°	1538	4°	1603
	7°	2100	7°	2192
	10°	2870	10°	2632
	21°	4000	21°	3610

TABLE OF THE RANGES OF ENGLISH MORTARS AT AN ELEVATION OF FORTY-FIVE DEGREES.

13 inch long range.		13 inch.		8 inch.	
Charge.	range.	charge.	range.	charge.	range.
2 lbs	690 yds	1 lbs	318 yds	½ lbs	235 yds
4	1400	2	697	1	638
6	1900	3	1132	1½	1028
8	2575	4	1490	2	1357
10	2975	5	1824	2½	1700
12	3500	6	2095	3	1919
14	3860	7	2510	4	2485
16	3900	8	2706	4½	2536
18	4000				
20	4200				

TABLE FOR FIRING OLD FRENCH FIELD PIECES.

*Loaded with fixed ball cartridge.**

	Guns.			6 in.
	12	6	4	hwtz
Service charge, (in guns $\frac{1}{3}$ of the weight of the ball.)† . . .				oz. 18
Powder that throws the ball of the eprouvette mortar 240 yards.‡				
Distance of the mark. yds.	in.	in.	in.	in.
1000	$1\frac{1}{2}$	$1\frac{1}{3}$	$1\frac{1}{4}$	1 gr
900	$1\frac{1}{12}$	1	$\frac{11}{12}$	
800	$\frac{2}{3}$	$\frac{2}{3}$	$\frac{7}{12}$	
700	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{4}$	
600		$\frac{1}{12}$	$\frac{1}{12}$	$3\frac{3}{4}$ §
550	P. B.			
520		P. B.		$2\frac{3}{4}$
470			P. B.	
	feet	feet	feet	
400	4	4	$2\frac{1}{2}$	$2\frac{1}{4}$
300	7	7	$6\frac{1}{2}$	$1\frac{1}{2}$
200	6	6	6	1
Ranges at an angle of 45 degrees.	yds. 4000	yds. 3560	yds. 3250	yds. 2600 with 30oz

The figures in the columns, that are higher than the point blank, show the length of the divisions of the hausse that are to be used in aiming at the mark.

The figures below the point blank show that the line of sight must fall that distance below the object.

* In firing with loose balls, the hausse must be raised two lines more.

† The charge in the schools is only one quarter of the weight of the shot in firing with loose balls.

‡ If the powder were weaker, it would be necessary to raise the hausse; for instance, the point blank range with powder that throws the ball of the eprouvette only 200 yards is 480 yards, and it is necessary to raise the hausse two inches to throw the ball 1000 yards.

§ Howitzers have no primitive point blank, because the diameter, at the swell of the muzzle, is equal to, or greater than that at the breech. The howitz will contain 23 and a half ounces of powder, but 13 is enough to burst it.

*Loaded with wrought iron case shot cartridge.**

		Guns.			6 in.
		12	6	4	hwtz
Charge of powder $\frac{1}{4}$ more than in firing balls.					
	yds.	in.	in.	in.	
Distances, and corresponding elevations of the hausse.	800	$1\frac{1}{2}$	$1\frac{3}{4}$		
	700	$\frac{10}{12}$	$1\frac{1}{6}$	$2\frac{1}{3}$	
	600	$\frac{5}{12}$	$\frac{2}{3}$	$1\frac{1}{2}$	
	500		$\frac{1}{2}$	$\frac{1}{2}$	
	200	.	.	.	.

Note. In pieces loaded with ball cartridge, the fire is efficacious at a distance of 1200 yards, in 12 and 8 pounders, and of 1000 in the 4 pounder. Guns may be used at even greater distances, (because when raised on their carriages the range is nearly doubled;) but the aim is by no means certain, at even the distance above mentioned. In pieces charged with heavy iron grape shot, 650 yards may be allowed for the ranges of the 12 pounders, 550 and 400 for the others.

FIRE OF BATTERIES IN THE DEFENCE.

The initial velocity that ought to be given to the ball being, in many instances, from 1000 to 1200 feet per second, the following will be the charges of powder to produce it.

Guns,		24 pr.	long 12 pr.
Velocity.	1000 feet.	℔$3\frac{1}{4}$	℔$1\frac{1}{2}$
	1200 feet.	$5\frac{1}{2}$	$2\frac{1}{2}$
Ranges of French pieces of these calibers at an elevation of 45 degrees.		yds. 4900	yds. 4050
Point Blank range with a charge $\frac{1}{3}$ of the weight,		700	560

* This table answers for the larger kind of grape shot only; if the smaller is used, the distances must be diminished 200 yards, or the elevation increased.

FOR FIRING BATTERIES IN BREACH.

In order to begin a breach, the ball must have, if possible, an initial velocity of 1,500 feet per second. This requires a charge of powder equal to half the weight of the ball.

To complete the breach, the velocity need not be more than 1,200 feet at most, which does not require a charge heavier than one fourth of the weight of the ball.

TABLE FOR FIRING MORTARS OF THE FRENCH CALIBERS.

This table shows the ranges of mortars, fired at an angle of 45 degrees, with different quantities of powder ;* and the ranges at different elevations with similar charges.

Caliber of the mortar, .	12 inch	8 inch	Stone Mortar.
Charge in French weight, .	1 lb.	5 oz.	
Range at an angle of 45° .	415 yds.	350 yds.	
do. 30° .	350	300	
Charge, ...	$2\frac{1}{2}$ lbs.	15 oz.	
Range at an angle of 45° .	1050 yds.	1250 yds.	
40° .	1100		
Charge with full chambers, .	11 lbs.	1 lb. 4 oz.	$2\frac{1}{2}$ to 3 lbs.
Range at an angle of 45° .	2880 yds.	1400 yds.	300 yards
Charge of the long range 12 inch mortar, . .	30 lbs.		
Range at 45° . . .	4260 yds.		
Charge of shells when full, .	17 lbs.	4 lbs 1 oz.	
Charge to burst them, .	4	1 lb.	
Weight of load of stone mortars			80 to 100 lbs.

A 10 inch mortar was formerly used ; when of a long range, and elevated at an angle of 45°, with a charge of $6\frac{1}{2}$ pounds of powder, it threw its shell 3,000 yards ; when of a short range, and with a charge of 3 lbs. 10 oz., it carried 2,300 yards.

The small mortar, called Coehorn, used in the defence of places, is of the caliber of a 6 inch howitzer, and the conical form of its bore permits howitzes of 6 inches, and of 5 $\frac{7}{12}$, (called 24 pound howitzes,) to be thrown from it. It weighs 218 lbs.

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* The powder used carried the eprouvette ball 220 yards.

NOTE. "Shells of a lower caliber may be thrown from mortars, either by filling the space round them with earth, or by fixing them in their place with wooden wedges.

"If the 12 inch mortar is used to throw 8 inch shells, a charge of $1\frac{1}{2}$ lbs. of powder will throw the shell 130 yards, and one of $2\frac{1}{2}$ lbs. 430 yards." (*Gassendi.*)

OF FIRING SHELLS FROM GUNS.

"In order to do this, the gun must be placed with the breach on the ground, and its recoil checked by a beam, inclined in such a way that the axis of the piece may be perpendicular to its face. It must be supported by a pile of blocks, strengthened by stakes, and placed just in front of the second reinforce, that support the gun, at an elevation of 40 or 45 degrees. A band of rope is put round the neck of the chase, in which is inserted an iron thimble. This thimble is placed on the upper side of the gun, and one of the rings of the shell tied to it with a slender cord, by which it is held upon the mouth of the gun. This cord must be in the vertical plane that passes through the axis of the piece, and the shell must be applied exactly over its mouth. In this way the direction is obtained with accuracy." (*Gassendi.*)

It has been found, by experiment, that 2 lbs. of powder which carried the ball of the eprouvette 200 yards, have propelled an 8 inch shell 130 yards from a 12 pounder; 4 lbs. have carried it 320 yards; and 5 lbs. 430 yards.

NOMENCLATURE

OF THE DIFFERENT PARTS OF CANNON, GUN-CARRIAGES, CAISSONS, AND THEIR IMPLEMENTS.

OF THE GUN. (pl. 1. fig. 1.)

b The Cascable knob, or button.
c The Neck of the cascable.
d The Breech.
s The *Hausse*, or moveable sight, fitted to the breech, (its graduated limb, and tangent screw, its plate and rivets.)
p The Base-ring.
l The Vent, or touch hole ; (in brass pieces, the vent is bushed.)
r The First Reinforce.
p The First Reinforce ring.*
f The Second Reinforce.
h The Dolphins, or handles.
e The Rimbases.
t The Trunnions.
p The Second Reinforce Rings.
v The Chace.
a The Muzzle Astragal.
n The Neck of the Chace.
m The Swell of the Muzzle.
o The Sight, cast upon the Muzzle.
q The Lip.
i The Mouth.
— The Bore is the interior cavity.

The mouldings are the fillets of the astragal and cascable ; the base ring and reinforce ogees ; the breech torus ; the breech and muzzle mouldings, &c.

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* There are some pieces that have no reinforce rings, others that have a vent astragal, as is shown at *à*. *Author*.

The iron guns, made in the United States, have a vent-astragal, but only one reinforce, and no reinforce rings ; there are also some old English captured guns that, in addition to all the parts above-named, and the vent astragal, have an astragal on the chase. Tr.

OF THE HOWITZER.

The Cascable, its knob and neck,
The Breech and *Hausse*.
The Base ring.
The Vent.
The Reinforce.
The Dolphins.
The Rimbases.
The Trunnions.
The Chace.
The Muzzle ring, and sights cut into it.
The Lip.
The Mouth.
The Bore.
The Chamber.

OF THE MORTAR AND STONE MORTAR.

The Breech of the Mortar.
The Trunnions, and their rimbases, (the bed in those mortars, that have beds cast on them.)
The Pan.
The Vent.
The Reinforce.
The Chace.
The Handle and Sight.
The Lip.
The Mouth.
The Bore.
The Chamber.

OF FIELD GUN-CARRIAGES.*

Two flasks ; 3 transoms, (breast, pointing, and trail ;) the pointing plate ; two large wheels, each composed of naves, spokes, and fellies.

Iron Work of Gun-Carriages.

Handspike ring, its bolt, eyed bolts and nuts.
Handspike hook, its key, chain and staple.
Straight pointed spunge hook, and forked spunge hook, with their bolts, chain, eye bolt, screw and nut.
Draught hooks for the head of the carriage.

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* No more is given here than the nomenclature necessary in field service ; any further detail will be treated of under the head of construction.

Breast plates for the head of the carriage, and Trail plates to reinforce the flasks beneath.

Trunnion plates, set into the flasks, their chin bolts with flat and round heads, their rivets, nuts, and screws.

Capsquares, their joint bolts, chains, spring keys, and staples.

Wheel counter-friction plates, swivel-tree counterfriction plate.

Chain to lock the wheels, its key, rings, and hook.*

Axle-tree bands and side straps.

Bucket hook.

Manœuvring, or supporting rings, (placed on the upper side of the flasks.)

Pointing, or elevating screw, and its winch, rivet, and sockets.†

Band and plate of the pointing plate. Base for the pointing screw.

Staple, and two rings, for the port fire and quick match stocks, (placed on the inside of the right flask.)

Upper and lower pintle plates. Lashing ring, and its bolts.

Pointing rings, and hoops that clench their bolts, double retreat hooks.

Connecting bolts, and an assortment of nails.

The iron axle-tree, its two arms, and their eyes ; washers ; washer hooks, linch pins.

Note.—Some carriages have false trunnion plates, by means of which a gun may be fired from the carriage of a heavier caliber, for instance a six pounder, on the carriage of a 12 pounder. These false plates are fixed to the flasks, by spring keys, and chains.

Of the Iron Work of a Wheel.

Six tires, 48 common nails, 12 screw nails, with rose and nuts, 6 fellie clenching nails, with rivets and counter-rivets.

Two hoops at the small end of the nave, 2 cordons fixed by

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* There is also a method of locking the wheels by means of a rope with a loop at its end, and a billet of wood : this is used to replace the chain.

† The sockets are irons set upon the inside of the flasks to receive the trunnions of the pointing screw.

means of 3 caboches, (or small nails with head,) brass box, and its cramp hooks.

N. B. The limber wheels have but 5 felliers, 10 spokes, 5 clinched nails, 5 sunken bolts, 5 tires, 40 common nails, and 10 with screws; the rest as for large wheels.

OF THE LIMBER OF A FIELD CARRIAGE.

The pole; 1 swing tree bar; 1 hinder swing tree bar; swing trees; 1 wooden body of the axle-tree; 2 hounds, or guides.*

A bolster,† and a sweep bar,‡ (when the ammunition box is framed with, or permanently fixed to the limber, there are 2 bolsters and 2 sweep bars, one of which bears the main pintle; there are, besides, two hound buttresses, and one supporter.)

Iron Work of the Limber.

The bolster cap, and the bolt of assemblage, with the body of the axle-tree.

The hurters;§ two forked under straps;‖ the axle-tree under straps, which serve to connect together the ends of the bolster with those of the axle-tree.

The pintle; the lashing chain, and its straps.

The swing tree hooks; the hounds, or guide's cap, (the body of which lies on the head of the pole) square plates for the head of the pole.

The eye bolt, with rings to fix the prolonge; (it is stopped by the pintle, &c.) prolonge cleats; sweep bar friction plate;

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* The hounds, or guides, *(armons)* are two braces set in the wooden part of the axle-tree, and through the bolster; which are so placed as to have their head close together in front, leaving only between them the necessary space to receive the pole, or the tetard of the thill.

† A bolster is a piece of timber placed immediately above the axle-tree, or wooden body of the axle-tree, and which is joined to it by several iron pieces.

‡ A sweep bar is a piece of timber which keeps the hounds firm in rear of the bolster.

§ The hurters surround the ends of the body of the wooden axletree; their ends are entailed of all their thickness in its sides.

‖ The forked understraps connect the iron axle-tree to its wooden body; they terminate in the shape of a fork where the end of the bolster cap is lodged.

sweep bar understrap, to keep the prolonge; bolts; screws; and *rosettes*, (these are small flat rings, often used by the French at the small end of bolts, before the nut, or clinching strap, is placed.)

The bolt of the pole, (it is lodged in the first hole of the hound's head.)

The Roman pin, (it serves to steady the pole;) in bad roads they take it off to let it swing freely, and give less fatigue to the horses.

The pole's head iron understrap, and cap, and its hooked iron upper strap, and cap; cramp irons, to fix the chains on the same.

The hook bolt, with ring and strap placed length-ways above the pole.

The pole chains and rings; swing tree bar, and swing tree plates; flat rings to fix them; great swing tree-bar-ring.

The Iron axle-tree; linch pins, and washers.

There are besides the bolts, pins, nuts, and small bolt rings, (*rosettes.*)

OF THE LIMBER, OR AMMUNITION BOX.

The box, cover, pinions, compartments, and the arms, (or handles.)

Iron Work of the same.

The cover, in sheet iron, or copper-hinges; the hasp and staple; the knob, (*tourniquet*) and its bolt.

Corner straps at the angles, and double corner straps to connect the sides and the bottom; straps for the arms; bolts.

OF THE THRILL.

There are limbers with shafts or thrills in lieu of a pole, when the shafts of the pole are fixed between the bolster and the body of the axle-tree; in a limber they say that such a limber is with shafts, (*à bras de limonière*) such is the siege-carriage-limber, intended for a flat country.

When the limber receives between its hounds (*or girds*) the

tetard* of a thrill, it is termed : limber with a thrill, such as those intended for mountain artillery. This thrill is moveable, and composed of two arms, a transom, a brace,† a tetard, and its wooden pin.

Iron Work of the Thrill.

Braces of the shafts, straps, and pins; team-hooks; tetard's cap and plate; hook straps with rings; back draw-hooks; (*ragots*) they are obliquely fixed on the shafts, and facilitate the drawback.

Thill's bolt, with its double catcher and small chain; eyed iron pin, with its buckle; nails to fix it.

N. B. When they add a horse abreast with that of the thrill, they add sometimes a recoil cross-bar, to prevent him from touching the wheel; the iron work of this consists of a supporter, which answers to support this cross-bar, both when it is projected; and when being not used, they wish to keep it under the shaft of the thrill; a key, with a small chain and pin, to fix the end of the supporter in the hinges.

SLED CARRIAGE FOR MOUNTAINS.‡

2 Flasks; 3 transoms, and 2 wedges, if there is no pointing plate; 2 small trucks; 1 swing tree.

Principal Iron Pieces.

Trunnion plates; flask covering bands; travelling trunnion plate-cap-squares; axle-tree; shoulder plate-locking pins, and small chains; harness chains; truck plates; hinges for the *chevrette* straps, or eye bolts to press the hooks of these straps into.

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* A tetard is a piece of square timber, which joins the thrill to the limber; one of its ends being fixed between the two hounds, and the other one in the transom which unites the shafts of the thrill.

† A transom is generally a piece of timber which assembles two others; a brace has also the same propriety; the first, however, is much stronger, and nearly of the same thickness as the pieces which it unites.

‡ In order to avoid repetition as much as possible, I will, in what immediately follows, only give the principal pieces of the iron work, and essentially those which have not yet been mentioned.

SLED CARRIAGE, (CHEVRETTE.)

Two uprights; 1 transom; 1 body of axletree, and 2 wooden trucks.

Principal Iron Pieces.

Axle-tree; transom plates, upon which the flasks bear; chevrette bolt; chevrette straps, to fasten the chevrette to the carriage; one more axle-tree, and what belongs to it, is wanted for the sled carriage.

SIEGE CARRIAGES.

Two flasks; 4 transoms; 1 pointing plate; 1 wooden axle-tree; two wheels.

Principal Iron Pieces.

Covering bands; reinforce plates; trunnion plates, and cap-squares; plate of the pintle-holes; flask assembling straps; pointing vice, and its nut; (for the axle-tree) under plate* of the axle-tree;† forked straps of the axle-tree under plates; hurters;‡ iron strap hooks and rings for the ends of the axle-trees, and axle-tree understraps.

As to the wheels, there are essentially 24 bolts, with nuts, and bolt rings, (or roses,) the boxes are iron, and divided into two parts.

N. B. The nave of the wheels, the axle-tree of which is of wood, has, in its interior, two shouldered iron boxes, whilst a brass box occupies all its interior part, when the axle-tree is iron.

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* The underplate of the axle-tree is placed under the wooden axle-tree, in order to strengthen it.

† The forked strap of the axle-tree underplate, are to join and keep together the under plate and the axle-tree.

‡ The heurtequin for wooden axle-trees, is an iron plate fixed to the shoulder of the body of the axle-tree, which it surrounds, to resist the friction of the nave; it is placed on the upper part of the spindle; its strongest part let into the shoulder of the axle-tree, and its straps' end in the spindles.

THE SIEGE CARRIAGE LIMBER, FOR THE PLAIN.

Two shafts of the thrill ; 1 transom ; 1 bolster ; 1 wooden axle-tree ; 2 wheels.

Principal Iron Pieces.

Sunken pins ;* axle-tree under plates ; axle-tree under plate straps ; heurtequin ; ring with hook and strap ; bolster, and axle-tree stirrup ; (or straps, joining and keeping together the bolster, and the axle-tree,) bolster's cap ; pintle ; lashing chain ; breech-hooks to fix the team.

GARRISON CARRIAGES.

Two flasks ; 2 transoms ; 1 pointing plate ; 2 supporters ; 1 wooden axle-tree ; two wheels.

Principal Iron Pieces.

Cast iron truck ; its axle-tree ; pointing vice, its nuts and crapaudines ; bands, straps and hooks for the axle-tree ; friction bands of the pointing plate ; clamped plates ; assembling pins and bolts ; nuts ; roses ; tenons ; iron straps ; hooks.

PLATFORM FRAME.

One hurter, which forms the front part of the frame ; 1 bolster, and 3 transoms ; 2 sides of the frame, formed by two sills, and 2 strips ; 1 groove for the truck, formed by 1 sill and 2 strips ; a stool on the frame, to enable the gunner to point (*coussinet d'auget*) and 6 wedges.

Principal Iron Pieces.

Bolster, groove, and sill bolts ; ear bolts, their nuts and rose ;

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* These sunken pins (*seyes*) are strong iron pins, whose head and end are sunk into the wood ; they fasten together the bolster, the shafts of the thrill, or the hounds, and the axle-tree.

iron plates to support the groove; transom rim strap, or band; pintle; hold fasts for the wedges; pins for those of recoil.

SEA COAST CARRIAGES.

Two flasks; (each of three pieces, assembled by 20 pins;) 2 transoms; 4 echantignolles,* and 4 pins; one large, and 1 small roller, with their recoiling blocks; 1 pointing plate, (to support the pointing wedges when the pieces are short.)

Principal Iron Pieces.

Hoops for the great roller; smaller ones for the little reinforcing bands; bolts used as pins; assembling bolts; pointing vice, its female screw, &c.

THE GREAT FRAME.

Two sides or cheeks; 4 transoms; 1 echantignolle; two strips; 4 recoiling blocks; 2 supporters for the trucks.

Principal Iron Pieces.

Cast iron trucks; supporting straps and under straps; assembling and supporting bolts; pintle; brass crapaudines, (brass pieces, between which the wheels turn;) straps to contain the pointing handspikes; clamped washers, (or flat *rondelles.*)

THE SMALL FRAME.

Two wooden sides or cheeks. Three transoms.

MORTAR BEDS.

Two flasks, (they are commonly of wood for small calibers, but of cast iron for the large;) two transoms; one bolster.

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* An *echantignolle* in general, is a piece of timber which serves to reinforce another, or give it more elevation.

Principal Iron Pieces.

Assembling bolts ; bolts and sockets of the tenons of manœuvre ; (trunnion plates and pins for the wooden flasks,) bolsters ; handles or trunnions with their plate ; reinforcing plate of the bolster's slope ; false square to bear the levelling coin ; double chin-bolts ; female screws ; ferulas.

N. B. There are mortars which have a bolster of brass cut in a hollow slope in front in order to receive the mortar's trunnions, and raise them one-fourth of an inch from the bottom of the notch ; They are let into the flasks, and thereby prevent, on the latter, the effect of the firing.

There are coast mortars, to which they give the degree of elevation by means of a vice with a female screw ; the head of the vice is supported by two moveable straps, fixed round a bolt, which traverses every flask.

Flat Moveable Frame, (Plateau,) *for Plaque Mortars.*

It is made of three bottom-joists, or sleepers, assembled by wooden pins ; bolts, and manœuvre tenon sockets, their roses and nuts.

N. B. Some of those flat moveable beds, to which, for the facility of replacing them to battery, an iron cylinder, hollowed in its middle, has been adapted in front, and two trucks in rear.

THE CAISSON.

Arms, (*brancards,*) rear clamps, or echantignolles, cross-bottom bars ; upper bolster of the axle-tree ;* upper bolster ; (*lisoir,*†) axle-tree and its transom ;‡ the body of the caisson ; ends of

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* The upper bolster of the axle-tree (*la hausse,*) is a piece of timber laid above the axle-tree, and used to fix the pole, and to serve as a *point d'appui* for the bottom of the carriage body ; the fangs of the axle-tree are fitted into it.

† The upper bolster, (*le lisoir,*) is a piece of timber, which in carriages, bear immediately upon the bolster of the limber ; it has an iron cap bolted to it, and a hole through which the pintle passes : as it is filled into the arms, it prevents them from spreading.

‡ The transoms of the axle-tree (supporters.) The name supporter is given to several wooden pieces, which differ by their form, place, and use ; in this case it is called the transom of the axle-tree, as it serves to assemble the arms in the rear, and strengthen the axle-tree.

the same ; three principal divisions ; a small interior box, (to contain 1,500 flints :) a small exterior chest, (to contain some tools and small spare pieces, or some fat, and lined with tin to that effect ;) the cover, with its five pinions ; the wheels.

Principal Iron Pieces.

Eyed and ring bolts ; iron pins with flat ends ; small chains and hooks to carry the pick-axes, shovels, and the spare sponges ; hinges, hasps, and their bolts, for the cover and reinforcing bands, to fasten and keep together the assembled pieces ; sheet iron, or copper, to cover ; covering band and its strap to fix it ; corner hoops, to keep the sides and ends of the caisson ; iron straps for the hinder ends of the arms ; assembling bolts ; an under plate of the axle-tree, and an under strap.

See the limber of the field carriage ; it differs very little from this, as to its nomenclature.

AMMUNITION OR DIVISION WAGON.

Arms ; transom ; upper bolster ; cross bars ; upper bolster of the axle-tree ; staves* for the side of the wagon ; raves ;† fore and hind-gates ;‡ planks, wheels, and its limber.

Principal Iron Pieces.

Corner straps for the arms and transoms ; upper bolster cap, with its bolts ; braces under the fore part of the wagon ;

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* The staves *(roulons)* are small pieces of timber which border the sides of wagons and carts ; their ends are set in the raves, and in the arms, or in the shafts of a two wheel cart.

† The raves are pieces of timber which form the upper part of the sides of the wagons and carts ; they are parallel with the arms in wagons, and with the shafts in carts ; it is in the raves that the end of the staves enter.

‡ The fore and hind gates, (in French *hayon*) are an assemblage of small pieces of timber called hind head bar, bottom planks, and staves, which serve to shut the wagons' fore and hind parts ; the name of hind-head-bar (*tresailles*) is given to the upper part, which is bored at its two extremities, so as to admit the round head of the raves ; bottom planks are those which form the bottom of the chariot, and upon which the load essentially bears.

esses, or linch pins of the fore and hind gates, with little chains; sockets of its hind gates, and its hook; hook straps, to carry the spare poles; iron axle-tree; axle-tree plates; washers, &c.

FOUR WHEEL FORGE.

Arms; transoms; braces for the hind transom; bottom plank; upper bolster coal box; blacksmith's tool chest, locksmith's, &c.; bellows, with see-saw and handle; pails; wheels.

Principal Iron Pieces.

The counter heart; (a plate of sheet iron raised vertically, and pierced by a round hole for the bellows nose,) the plate to reinforce the counter heart; its two supporters, bolts, &c.; the hearth, composed of 3 plates of sheet iron; supporting plate, and strap to connect the counter heart with the bottom; a jamb, (*garde frasier*,) its iron straps, and bolts; the cast iron nose, (*tuyere*,) its plate, upper and under iron; cap square; (*porte tuyere*,) the uprights for the see-saw and handles; cross bar, and supports for the uprights; other supports for the trunnions of the bellows; and a plate for the manœuvre; square plates of under straps, for the bellows nose. There are, besides: bolts, an iron axle-tree, &c. the rest, as with other carriages; as limber, &c.

THE BELLOWS

Is composed of 3 boards, the middle one is termed *diaphragm*; sucker; reinforces; cross-bar; frame; nose; and the leather.

Principal Iron Pieces.

Sheet iron covering plate for the fore part of the diaphragm; trunnion plates to carry the bellows hinges; hoops and straps for the neck; its tube or pipe* of sheet iron, and its tenon; thin bolts, female screws, &c.

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* This pipe or tube, (H) is called in French *buse*—that part of the bellows which serves as a canal for the wind.

THE CANNON OR BOAT WAGON.

The two carriages; the coupling perch;* the long wooden fork;† and the short fork;‡ hounds; bolster; pole, &c.

THE TWO-WHEEL CART.

The two shafts of the thrill; the bottom planks; staves; stancheons hasps; staples; hinges, &c.

THE SLING WAGON, (*Triqueballe.*)

The pole; wooden forks; wood axle-tree; the bolster; the wheels.

Principal Iron Pieces.

Plates of the upper and under pintle holes; lashing ring; understraps of the axle-tree; hurters; iron hasps, with rings; forked straps, at the end of the axle-tree; bolts; straps, &c.

The limber is with a thrill. (See before the thrill.)

In the sling wagon, with vice, there are, besides the vice, its handles, and female screw; the eyed pins, to support the load in part; pot-hooks or saw-like cramps; (*crémaillere,*) collars; supporting plates; friction plates; bolts; roses; nuts, &c.

THE GIN.

The legs; clamps; narrow planks; roll; cleat and prop.

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* The coupling perch is a piece of timber which, passing through two carriages, serves to unite them. The small end of this coupling perch has many holes for linch pins, in order to keep them closer or farther apart, according to the burthen which they carry. (In order to avoid mistakes they have agreed in artillery never to give to a carriage pole the name of perch, tongue, &c.)

† That large wooden fork, (*empanon,*) is a forked piece of timber, the two arms of which are fixed upon a limber, and which serves to join at pleasure this limber to a pole

‡ The short wooden fork, (*fourchette,*) a sort of shorter *empanon* which fixes the coupling perch with the fore carriages.

Princial Iron Pieces.

Gin's cap, its bolt and clasp; block bolts; reinforcing bands; hoops and iron points of the legs and prop; plate and handle of the prop; hoops of the roll; single block, with its strap and hook, or double pullies with forked strap, hook and bolt. The coast gin has two wheels, with notches and the two clasps.

ARTILLERY, ARMS, AND IMPLEMENTS FOR THE FIELD PIECES.

Rammers and Sponges.

For the pieces of a small caliber, the sponge with crooked handle is used, and serves at the same time as a rammer. The crook is an iron hook ending in tubes, at the end of one of which a wooden handle is entered and fixed. As to the large caliber pieces, the handle is straight, and has a sponge cylinder at one end, and a wooden cylinder at the other. (Fig. 3.) Brass ferulas, brass nails, Russia swine bristles. The cylinder or head of the rammer must be about half an inch less than the caliber of the piece, and that of the sponge an inch less; the handle must have at least six inches more than the length of bore of the piece; its diameter is one inch and a half.

Of the Worm of a Gun.

It consists of a wooden handle and two branches turned in a spiral direction; (fig. iv.) every branch, when extended, is nine inches long, and half an inch in diameter, in its largest part; the socket is six inches long, and extends to four inches when open.

Priming Wires.

There are priming wires which have a wooden handle with ferulas; the iron needle of such priming wires has a shoulder which adheres to the handles; its sharp end is straight and shaped like a diamond's head, rather blunt. (fig. x.) There

are other priming wires without head, and the needle of which terminates at one end with a ring. (fig. xi.) Finally, there are some whose needle is in the form of a gimblet; they serve in extraordinary cases. They give a length of seven inches to the first of these priming wires, and a diameter of the sixth part of an inch. The part which enters the handles is called the match, and is two inches long; the length of the handle, four inches; its diameter, at the largest end, one and a half; and at the smallest, one inch. For the 3 pounder, only five inches are given to the needle in length, and its diameter is one quarter less.

The Port Fire Stock.

A wooden handle, having at one end two small sheet iron bands in the form of a pencil 11 inches long, (fig. 6.) with a small socket in its side, to place the port fire, the diameter of which is 1-2 an inch; 3 ferulas, one of which is moveable, to press the fire stock in the socket.

The Lin Stock

Is a staff about 2 1-2 feet in length, cut sharp at one of its ends, and split at the other, to receive the hanging end of the lighted match, which is twisted round. (fig. 7.)

The Port Fire Tube or Case.

Is made of strong leather, and consists of a case for about twelve port fires; a cover and a strap. (fig 14.) Proportions: 2 1-3 inches diameter; total length of interior part: one foot; that of the cover: 4 inches;* breadth of the strap: 1 1-2 inches. The upper part of the case, and the cover, have a reinforce leather 2 inches wide, with a bridle, through which the strap passes.

The Priming, or Quick Match Pouch

Is of strong, but soft leather. (fig. 12.) It is composed of a bag, 1

* I give here the essential dimensions of the small implements, which it may be useful to have made in the course of a campaign, when they are deprived of models or tables of construction.

cover, or leather piece which covers it, and a girdle with a buckle ; they give it 9 inches of breadth, and 7 of height ; the covering part is 6 inches high, and 11 broad ; the girdle is a strap 1 1-2 inch wide.

The Ammunition Leather Pouch

Is made of a strong, but soft leather ; (fig. 13.) it consists of a bag, two straps made round at the end, and sewn on the sides of the bag, a flap, or piece of leather to cover it, and a strap with a buckle, they give it one foot 4 inches in breadth, and an equal height ; the bands are 1 foot 7 inches long, and three inches wide when done ; the strap is 2 inches wide, and 4 1-2 feet long, one of which is for the little.

The Thumb Piece

Is a small cushion of strong deer skin, or soft leather, (3 inches square,) stuffed with hair or oakum, covered on one side with a skin, which forms a sort of a little bag, into which the gunner passes his fingers to shut close the touch hole.

The Bricole to draw the Piece.

Is made of a leather strap, a trace rope, a triangular iron ring which joins them, and a key, (fig. 15.) this strap, in its full length, is five feet and 3 inches wide ; the trace is 1-2 an inch in diameter, and 7 feet long, where the ring is placed, and the 3 inch buckle at the other end ; the key is placed in a trace, 4 feet distant from the end of the buckle, which is stuffed with small pack thread.

Of the Prolonge.

The prolonge is composed of a rope, two rings, and one key or billet ; the billet is fixed to one of the ends, a ring at 16 feet distance from it, and another 8 feet from the latter, or 24 from the billets ; the rest of the prolonge is to attach it to the limber ; and to make loops, if there are no rings. (fig. 20.)

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* They give it 1 inch diameter ; and at most, thirty-six feet total length. For the 3 pounders, it may have the 5th of an inch less diameter.

The Pointing Handspike,

Is of wood ; its small end enters a handle ring ; its butt end, a ferula and catching pin ; to prevent it from clearing the pointing rings, (fig. 8.) they give 5 feet 12 inches in length for the 12 and 6 pounders and howitzers, and 4 feet 4 inches for the 3.

The Field Carriage Water Bucket,

Is composed of 12 staves, 2 bottoms ; the under one full, the upper one bored, and having a bung ; its iron work consists of a handle, with a round eyed pin and ring to hook it ; two eyed cramps ; 3 hoops ; a small chain for the bung.

Locking Ropes.

The locking ropes, to supply the locking chains, consist of a cordage with two buckles, and a curved billet, which is in the shape of a tent picket ; they are 1 inch diameter, and about 5 feet long for carriages, and 6 for ammunition wagons.

N. B. In the field parks, fuse drawers and fuse drivers are provided with ; they are mentioned further.

OF THE ESSENTIAL ARMS AND IMPLEMENTS FOR SIEGE AND GARRISON CANNON.

The Sponges and Rammers,

As for the field pieces of large calibers ; with this exception : that they are divided ; that is, they use a staff for the sponge, and another for the rammer.

The Ladle, (Lanterne.)

The Ladles, (fig. 5.) which serve to load the pieces in case of need, when they are in want of cartridges, consist of the body of the ladle and its collar, made of copper sheets ; this collar is nailed on the head or cylinder of the ladle, which is of wood as well as the staff.

The Handspikes.

The butt of the garrison and mortar-carriage handspikes, is cap-

ped with an iron plate, in order that the end may not slip when they heave at the flask. This ironing is termed the armed part of the handspike, (*l'armure du levier.*)

The Cartridge Boxes,

Are cylindric or octagonal wooden boxes, to carry the cannon cartridges of garrison and siege. They consist of a box, a cover, 2 brass ferulas, and the rope to carry them; their diameter is proportioned to the cartridges.

The Priming Horn,

Is a powder horn, containing powder to prime with.

The Mortar Ladle, (Curette,)

Serves to clean the chambers of mortars and howitzers. One of its ends, shaped like a scraper, is made concave and sharp; it serves to scrape the rust and dirt which adheres to the bore of howitzers, mortars, and stone mortars. The other end, or ladle, shaped like a spoon, and obliquely fixed to the handle, is used to draw them out. They give 26 inches total length; 2 of which for the scraper, and 2 for the diameter of the ladle.

The Double Iron Hooks, (Crochets à bombes,)

Serve to carry the large bombs. They are shaped like an S, and are 16 inches long, measured straightwise.

The Spatula,

Is a sort of wooden handle, 2 feet long, ending in the shape of a small shovel, to drive in the small splints which fix the bomb.

The Splints

Are small thin wedges to steady the bomb in the mortar, they are of pine wood, 6 inches long, 1 broad, 1-4 of an inch towards the head, and ending like the sharp edge of a knife blade.

Of the Stone Mortar Tapeon.

This tapeon, which is placed above the powder in stone mortars, and upon which the stone basket is laid, is of wood ; its thickness is 1 3-4 of an inch, its diameter 1-6 of an inch less than the bore of the mortar.

Of the Basket. (*Panier.*)

The basket purported to contain the stones, is of willow branches, or other pliable wood ; its height is equal to its diameter, which is 2 inches less than that of the stone mortar bore.

Of the Stakes.

The stakes which are placed on the epaulement of mortar batteries, in the direction of the object aimed at, are small iron rods about two feet high.

Of the Fuse Drivers, (*chasse-fuseés.*)

The fuse driver purported to drive in the fuse of bombs and howitzes, is a piece of hard wood 6 inches long in all. Its inferior part 2 1-6 inches diameter, which is the largest, and termed its body, has, underneath, a socket, or cup, to set on the fuses ; the superior part of the fuse driver, which is termed the handle, is made round.

Of the Fuse Drawers, (*tire fusies.*)

The fuse drawers, which serve to draw forcibly the fuses out of the bombs and howitzes, whenever it is thought convenient to replace them, or unload those projectiles, are composed of pincers, an iron ring, and an iron frame, (fig. 9.) the pincers are cut hollow, and so arched inside as to seize the head of the fuses. The ring prevents the branches of the pincers from parting asunder. As to the iron frame, it consists of two hoops, assembled by four iron stanchions with shoulders to support the two hoops. The inferior hoop, is to embrace about a third of the projectile, and exactly bears upon its circumference. The superior serves as a prop to the small le-

vers, which are, commonly nothing but tool handles, which are made use of to pull out the fuse.

There are other fuse drawers; they have a great perpendicular vice, which, passing through a female screw, which joins together the superior part of the stanchions fixed by one of its extremities to the head of the pincers, while the other operates by means of a lever, which makes it turn in the female screw, and thus pulls out the fuse. The latter is more handy than the other, but not so plain, and much more difficult to construct in the field.

Of the Apron. (Chapiteau.)

The apron, or wooden cap, termed by the French *chapiteau*, is formed by two small bands 1 1-2 feet long, obliquely joined to each other, and placed on the breech of guns to prevent water from entering through the touch hole.

The Tampion. (Plateau.)

Is a wooden cylinder, or round plank, with a handle; it is set on the mouth of mortars, to prevent water from entering them.

EXERCISE OF FIELD ARTILLERY.

FIELD PIECES.

NECESSARY NUMBER OF MEN.

For the service of a gun of each of the calibers now used, nine men are required.

Experience has proved, for a great number of years past, that it is utterly impossible for 15 men at a 12 pounder or 11 at a 6 pounder, to draw them in heavy ground, or to advance or retreat with bricols during a battle. The number, then, established formerly for these pieces was too great for the mere exercise of them, and not sufficient to manœuvre them without horses. It is now well established, and admitted, that horses only should be used to draw the piece in action, and the prolonge for the facility and promptitude of manœuvring. The number, then, should be reduced to that which is necessary for the service of the gun, and not calculate for the use of the bricol; with the exception of a particular case, where you would be compelled to resort to that mode, which will be spoken of hereafter.

The number, then, which is deemed necessary to serve either of these calibers, will be as above stated.

2 Matrosses, to spunge, load, and ram.
2 do. to prick, prime, and fire.*
2 Gunners to tend the vent, elevate, and give the direction.
2 Matrosses to furnish ammunition.
1 Artificer, or corporal, to direct, attend the caisson, and issue the ammunition.

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* The second on the left may be suppressed by having his duty of pricking and priming the gun performed by the third man on the left, who has but little to do, but this is reducing the number to the lowest degree; besides, in quick firing, or in serving the 12 pounders, the cartridges of which are heavier, or the howitzer, whose service is more complicated, the second on the left may be advantageously employed, as an assistant purveyor; with 4's or 6's, one man, as purveyor, to furnish ammunition, may be sufficient.

In the horse artillery two additional men are required to hold the horses of the men who attend, and serve the piece in action.

A sergeant or corporal commands the gun ; he directs and superintends all the movements in action, and otherwise attends to its being provided with every necessary, and all kept in good order.

EQUIPMENTS AND IMPLEMENTS.

Sponge Staff,	with a curved handle for 4's and 6's without a rammer, straight handle with rammer for 12's, and howitz (8.) (Fig. 2 and 3.)
Hand-Spikes,	two for 4's and 6's, and four for 12's and all other calibers whose carriages have double trunnion plates.
A Linstock,	A Linstock.
A Port-fire,	A Port-fire case.
Port-fire Case,	
Priming Wire,	carried by the second on the left, or No. 4.
Tube Case,	

A Thumbstall, carried by the gunner on the left.

Four Ammunition Pouches, carried by matrosses ; Nos. 7 and 8, 4 and 2.

The Prolonge, fixed to the limber.

A Bucket, hooked on the right of the carriage.

To these may be added the *Ammunition Chest*, attached to the carriage.

It has been the custom to allow but two cartridge pouches for 4 and 6 pounders, and three for other calibers, but four appear necessary. The two purveyors, who supply the piece with ammunition, must each have one ; the first on the left, (who loads) must also carry one, to be supplied with a spare cartridge ; the second on the left should also be provided with one, being occasionally compelled to supply the piece from the ammunition chest.

The custom of omitting the caisson in the school of instruction, is a bad one; the men are, thereby, induced to depend solely upon the ammunition chest, which only should be resorted to in cases of necessity ; and the ammunition taken from it must be immediately replaced, as soon as the caisson comes up. The caisson is, therefore, represented at its position in battery, 45 paces in the rear, (Fig. 17 and 20,) by the man who has charge of it ; and the men who supply the piece with ammunition, must be practised to receive it, and depend upon the caisson.

In the exercise of the piece, (or school of the gunner,) it is supposed to be without horses.

In the school of the piece, and that of the battery, the horses are attached to it, as well as the caisson; they are likewise in the evolutions of batteries.

MANUAL OF THE PIECE.

Position of the men at the piece, which is on its limber, and without horses, (fig. 16.)

The first matrosses, (*or Nos.* 1 *and* 2,) abreast the muzzle of the piece, 18 inches without the wheel, facing the gun.

The 2*d matrosses*, (*or Nos.* 3 *and* 4,) abreast the naves of the large wheels.

The two gunners, (*G*) abreast the button of the cascable.

The 3*d matrosses*, (*Nos.* 7 *and* 8,) abreast the naves of the small wheels.

The artificer, or N. C. officer (*A*) at the caisson. Should there be no caisson, his position would be two paces from No. 8. His duty is to issue cartridges from the ammunition chest.

The chief of the piece, (*C*) if he command, is stationed in the rear of the piece; otherwise, on a line with the end of the pole, one step distance.

The right and left of the piece, as relates to the station of the men, is determined by the position of a man placed in rear of the gun, and looking to the front; but the reverse is the case with the limbers; its right and left are determined by the driver.

The detachment marching to take their stations, the front rank is composed of the men of the right; the rear rank, the left of the piece; order is given,

"*To your posts—march.*"

The men then oblique to the right and left, taking their positions, as stated above; when posted, the right dressing by the right; those on the left, by the left. Nos. 1 and 2, distribute the implements.

If the gun be on the travelling trunnion plate, the officer orders,

"*Prepare to change trunnions for action.*"

The 2d matrosses (or Nos. 3 and 4,) take off the cap squares;

No. 3, hooks the lock-chain to the highest spoke; the gunner and first on the left, (or No. 2,) take out the handspikes, give one to No. 1, on the right, one to the gunner on the right, and each retaining one.

"Change trunnion plate."

The first matross on the left (or No. 2,) introduces the butt end of his handspike half way into the muzzle of the gun; the first matross on the right, (No. 1,) and gunner on the left, place their handspikes under the button of the cascable and the first reinforce, and raise the piece, aided by the 2d matrosses, (or Nos. 3 and 4,) the gunner on the right places his handspike, as a roller, under the first reinforce, advances it to the centre of the piece, the ketch of the handspike passing over the left flask.

The first matross on the right, (or No. 1,) takes out his handspike, and crosses it under that which is in the muzzle; the gunner, on the left, then keeps the piece level, by passing the small end of his handspike through the right dolphin; the two second matrosses, and the third on the left, (or Nos. 3, 4, and 8.) go to the assistance of No. 1, on the right; the second on the right, (No. 3,) at the end of the handspike, assisted by the one on the left, (No. 8,) and the third on the right, (No. 7,) to that which is in the chase.

Steady—heave.

This command, given by the officer, or gunner, on the right, all act at the same time with force, precaution, and steadiness. In changing the piece to the action trunnion plate, the 3d matrosses, (or Nos. 7 and 8,) then resume their stations; the 2d, (or Nos. 3 and 4,) place the cap squares, (No. 3,) unlock the wheel, the two first, (Nos. 1 and 2,) press upon the chase, the gunners disengage their handspikes, place them against the ammunition chest; the gunner, on the left, raises the pointing screw; the one on the right, supporting the pointing plate; the first matrosses, (Nos. 1 and 2,) resume their posts, and replace their handspikes; the gunners replace theirs in the square rings.

TO DISENGAGE THE CARRIAGE FROM THE LIMBER,

The following word of command is given:

Unlimber.

The third on the right, (or No. 7,) raises the pole. When the piece is drawn by horses, and Nos. 7 and 8, employed at the caisson, the chief of the piece raises the pole, the gunner on the

right unhooks the limber chains ; and, aided by the one on the left, raises the trail. With 12 and 9 pounders, the 2d matrosses, (or 3 and 4,) assist them.

The 3d matrosses (Nos. 7 and 8,) advance the limber three paces, to make room for the trail.

The gunners take off the ammunition chest, and place it upon the limber, which is moved twelve paces in the rear, at the word *March*, given by the gunner on the right, (fig. 17.) inclining to the right, wheels to the left about ; the pole turned toward the carriage, and in its direction ;* at the same time the 2d on the left, (No. 4,) unhooks the handspikes ; he passes one to the 2d on the right, (No. 3,) and fixes them in the trail rings ; the first on the right, (or No. 1,) with the aid of (No. 2,) takes the sponge.

The 2d on the right (No. 3,) unhooks the bucket, and fixes the port-fire to the stock.

The men then are stationed in the following order : The piece arriving in rear of the line it is to occupy when in battery, to wit : the muzzle being to the rear, instead of ordering the piece to be unlimbered, the command would be, "*Form Battery.*" (fig. 18 and 19.) The piece is then unlimbered, as prescribed ; the ammunition chest being placed on the limber, it is wheeled to the left, passing by the right of the piece. When it arrives 15 paces in the rear, it is again wheeled to the left about, to its position of 12 paces from the trail of the gun ; as soon as the limber passes the gun, the gunners repair to the trail handspikes ; the 1st and 2d matrosses, (or Nos. 1 and 2, 3 and 4,) to the wheels, the trail is turned to the left on the left wheel ; the first on the left (No. 2,) placing his feet on the lower felloes of the

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* When the prolonge is loose, the limber is placed in an opposite position : in the above case the limber is turned toward the piece, that the horses may not run off, if they should be fixed to it ; the leading horses then would be about six paces from the trail of the carriage.

† The piece arriving before the line, necessarily fronting the enemy, it is in its position ; and to commence the fire, the piece is unlimbered, as mentioned above. (fig. 16 and 17.)

The piece is said to be in order of battle, when the pole is fronting the enemy ; (fig. 18) and when in position to fire on the enemy, it is said to be in battery.

wheel, supporting himself by the upper spokes. The men then take their stations of exercise in the following order:

POSITION OF THE GUNNERS AND MATROSSES IN BATTERY. (Fig. 17.)

ON THE LEFT.

The first matross (or No. 2) on a line with the muzzle of the piece, 18 inches without the wheels, facing the piece; he is provided with an ammunition pouch slung from right to left.

The second matross (No. 4) on a line with the button of the cascable, he dresses on No. 2, the priming wire in the right hand, the tube box round the waist, and an ammunition pouch on the left.

The gunner on a line with the middle of the trail-handspike, dressing by the left, the thumbstall on the second finger of the left hand.

The third (No. 8) carries an ammunition pouch. He is with the ammunition chest.

The artificer, or non-commissioned officer, who has charge of it, is stationed with

ON THE RIGHT.

The first matross (No. 1) on a line with the muzzle of the gun, 18 inches without the wheels, facing the piece; holding the sponge horizontally in both hands—the right on the end above the staff, and the left below it 2 feet from the sponge. With 12 and 9 pounders, both hands are below, the right in the middle of the staff.

The second on the right (No. 3) on a line with the button of the cascable, he dresses on the first, in his left hand he carries the linstock, and the port fire-stock in the right; the port fire case hanging on the left.

The gunner on a line with the middle of the handspike opposite, and facing the gunner on the left, dressing by his right.

The third (No 7) carries an ammunition pouch. He is with the caisson, near the non-commissioned officer in charge of it, or with the ammunition chest when there is no caisson.

The person commanding the piece, half way between the limber, and the trail handspikes;

ON THE LEFT.	ON THE RIGHT.
it 45 paces in rear of the limber, (fig. 17,) and when there is no caisson, he takes position in rear of the ammunition chest. (fig. 19.)	observing all that passes at the gun, the limber, and the caisson.

TO PREPARE FOR FIRING,

Order is given :

"*To Action!*"

The second on the right (Nos. 3) lights his port fire, half faces to the left, holds the linstock in the left hand, the port fire stock in the right—the arms without constraint.

To avoid the effect of the explosion, the first (No. 1 and 2 matrosses,) step to the right and left, No. 1 to the left, and No. 2 to the right, 18 inches, the knee bent, and the weight of the body resting on it; the opposite leg extended, the feet forming an angle a little more acute than the right angle, and equally open; the body steady and without constraint.

The third on the left (or No. 8) moves quickly with ammunitions, in rear of the first on the left (No. 2) with whom he changes pouches; if, with a 4 or 6 pounder;* but with a 12, a howitz, or an 8 pounder, he remains in the rear of No. 2, to hand him the cartridge—in the mean time, the third on the right (No. 7) who is to the caisson, returns and replaces him on the left, (No. 8) who, in his turn, seeks a supply of ammunition from the caisson. In case he does not arrive in time to keep up the supply of the piece, the one in rear of the first, on the left, (No. 2.) gives him what cartridges he may have in his pouch, and returns with expedition to the caisson.—In the event of the purveyors delaying in their supply, the second on the left, (No. 4.) would replace the deficiency from the ammunition chest.

The gunner, on the right, steps off with the right foot, places himself between the trail handspikes, directs the piece, resumes his position by his right, stepping on the left foot; and gives the word of command :

"*Load!*"

The gunner on the left, stepping off with the right foot, advances

* It is evident that when the matrosses have their bricols, they cannot exchange their pouches, since these are placed under the bricols.

to the breech of the gun, extending the left leg, the knee bent, the body thrown forward, he stops the vent with the left hand, seizes the elevating screw with the right, and gives the number of degrees.

The two first matrosses (Nos. 1 and 2) advance to load the piece. The one on the right, (No. 1,) steps out with the left foot; the other (No. 2) with the right; No. 1 sponges, observing that the vent is well stopped; No. 2 places the charge, and No. 1 rams down; (if it were a howitzer, No. 2 would take care that the fuze of the shell was uncapped, and he places it on the side of the chace.) The piece being loaded, they resume their stations, by a contrary movement.

The second on the left (No. 4) advances with the left foot, pricks with the right hand, places the tube with the left, resumes his position, stepping back with the right foot, and gives the signal to the second on the right (No. 3) to fire.

The second on the right (No. 3) raises the right arm without bending the wrist, so that the fire may not endanger the tube box, or the gunner on the left.

The piece being fired, it is reloaded in the same manner; the fire ceases by a roll of the drum, or by the word of command, "*to your posts;*" on which the 2d on the right (No. 3) extinguishes the port-fire, and each resumes his position.*

DETAIL OF THE POSITION OF THE FIRST, (OR 1 AND 2) IN SPONGING AND LOADING THE PIECE.

The matross, No. 1, being in action opposite the piece, the weight of the body is thrown on the left leg, the knee of which is bent, and the left foot opposite the axle-tree; the right opposite the astragal; the right leg extended; the feet equally turned out; the heel on the same line; he holds the sponge in both hands.

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* When the bucket is hooked on the right of the piece, as it was formerly, No. 3. has it in his charge to hook and unhook it at the words of command: *in action, and to your posts.* But when the bucket is hooked under the centre of the chase transom, it is unnecessary to unhook it to wet the sponge, which is more convenient, particularly firing in retreat with the prolonge. In the latter case, No. 1. is charged with the bucket, to see that there is always water in it, as his own safety depends upon it.

At the word "*load*," he resumes his erect position; raises the sponge as high as the breast, extending the right arm its whole length, to pass the sponge over the wheel; he steps out with the left foot, which he places on a line with the astragal; he advances the right foot 18 inches to the right of the left heel, on a line with it; the feet nearly square; the body inclined to the right; introduces the sponge (crooked handle) with the left hand into the piece; pushes it to the bottom with the right, the left hand sliding along the staff; the body is erect on the left leg, and parallel with the piece; he casts his eye on the vent, to see that it is well stopped; he sponges by turning the sponge two or three times round in the bottom of the piece; he then draws it out to admit the charge; the body again inclined to the right; the right arm extended its full length; the left hand six inches below the muzzle, to receive the sponge when it is drawn from the piece; rams home the charge, which is placed by No. 2, by pushing it with one stroke; draws out the sponge, and resumes his position of "*in action*," by stepping back with the right foot, bringing back the left foot on a line with the axle-tree.

The matross (No. 2) springs out, in the same position as No. 1, except that the body is erect on the right leg; the right foot opposite the spindle; the left foot opposite the astragal; the arms hanging in their natural position; at the word "*load*," he rises on the left leg, advances the right foot even with the astragal, brings up the left, places the charge with the left hand, (and when the staff is crooked,) he resumes his post in stepping back with the left foot; but with the straight staff, after having advanced the right foot to the astragal, he breaks to the left with the left foot, to assist No. 1 to sponge and ram home the charge; they resume their posts at the same time.

For 12's and 9's, the first on the right, (No. 1,) uses a sponge with the straight staff, which he holds in both hands, the nails uppermost; the left near the sponge; the right mid-way the handle; the second on the right assists the first in sponging, the hands of both interlock'd; they turn the sponge five or six times; and draw it out; No. 1. strikes it with his left hand; tosses the sponge end over to the right; lets the staff slide through his hand; and seizes it with the left hand near the rammer head.

The first on the left, (No. 2,) receives the cartridge on the left, and places it with the left hand; No. 1 rams it home with one stroke, assisted by No. 2, and they resume their posts.

TO CHANGE THE POSITION OF THE MEN OF THE PIECE,

The order is given:

"*Change!*"

All lay down their implements; No. 1 places the sponge against the wheel, the sponge uppermost; No. 3 places the port-fire stock against the wheel, the port-fire uppermost; No. 2 replaces No. 1; No. 1 takes the place of No. 3; No. 3 takes the place of No. 7; No. 7 that of No. 8, and so on, round the piece and limber.

Should it be necessary to change the gunners, the order is given:

"*Gunners—Change!*"

The gunner on the right passes round the trail handspikes to the left; the one on the left passes over the trail of the piece.

TO LIMBER UP THE PIECE, TO MOVE TO THE REAR,

The word of command is given:

"*Advance—Limber!*"

The first on the right, (No. 1) assisted by No. 3, places the sponge in the rammer hooks, and keys them; Nos. 7 and 8 advance with the limber, obliquing to the right, so that turning to the left about, they may be three paces in the rear of the trail transom; the gunners unfix the handspikes, pass them to the second on the left, (No. 4,) who, with the assistance of the first, (No. 2,) fixes them in their places; the gunners take the chest from the limbers, and place it in the recess of the checks of the carriage; raise the trail; push back the limber, so that the carriage can be placed on the pintle; the gunner on the right then hooks the lashing chain, and all resume their posts. When the matrosses, (Nos. 7 and 8,) attend the caisson, the chief of the piece directs the pole, in order to place the main pintle.

THE PIECE BEING IN BATTERY, AND BEING NECESSARY TO ADVANCE,

Word is given:

"*Advance—Limber to the front!*"

The third matrosses, (Nos. 7 and 8,) advance the limber three paces in front of the muzzle of the gun, passing to the right; the gunners, and men, keep close to the flasks, to let the limber pass; the gunners step to the trail handspikes; the matrosses on the right and left to the wheels; and the piece is turned to the left about, and fixed upon the limber, as before stated.

IF IT IS INTENDED TO CHANGE THE PIECE TO ITS TRAVELLING TRUNNION BED,

The officer orders :

"*Advance Limber—Change Trunnion Beds.*"

The gunners unfix the trail handspikes ; pass them to the seconds, (Nos. 3 and 4,) who hand them to the first, (Nos. 1 and 2 ;) the piece is then fixed on its limber ; the seconds, (Nos. 3 and 4,) take off the cap-squares ; the one on the right, (No. 3,) locks the wheel at the lower spokes ; the gunners place the handspikes which they had drawn from the rings, against the arms of the ammunition chest ; the first on the left (No. 2) introduces his handspike into the muzzle of the piece ; the first on the right, (No. 1,) has his right hand placed on the muzzle ring ; assists No. 2 in pressing down the gun to raise the breech ; the gunner on the right raises the pointing plate, and the left turns down the screw to the supporting transom ; the remaining part of the manœuvre has been already explained in a former change of the trunnion plates.

To enable the gunner on the right to disengage his handspike, the gunner on the left enters his handspike under the button, and the first on the right (No. 1) places his under the first reinforce, and with the assistance of the second, (Nos. 3 and 4,) they raise the breech ; the cap squares and handspikes are replaced.

THE PIECE BEING ON THE LIMBER, AND THE PROLONGE BEING REQUIRED,

The order is given :

"*Unlimber, and fix the prolonge.*" (Fig. 20.)

The limber being taken off, the trail on the ground, and the ammunition chest placed on the limber, the gunner on the left, loosens the prolonge,* the gunner on the right passes the tangle through the lashing-ring, and through the loop under the guides ; the prolonge is then double, (or 12 feet long ;) this is the length used for firing in retreat, or advancing ; and this is the length

* Heretofore it was customary to employ the third on the left, (No. 8,) to loosen the prolonge of the 6 pounder ; and by others, according to the calibers ; but he may be absent, engaged in supplying ammunition ; besides, the men at the gun should perform all the duties of it ; it is more simple and uniform to have the prolonge of every caliber attended by the same man, (the gunner of the left,) who, with the gun on the right, is employed in this manœuvre, instead of depending upon the purveyor.

always implied, when the prolonge is ordered to be fixed; unless for flank firing, &c. in which case, the order is,

"*Fix prolonge—for flank firing.*"

The tangle (or billet) is passed through the lashing-ring, and the loop, which is 9 feet from the sweep-tree; the prolonge is then 18 feet long; the gunners repair to the handspikes; the seconds (Nos. 3, and 4) to the wheels, to advance the piece beyond the flank of the column, to execute this fire. The prolonge must be slack, that the gunner on the right may not be incommoded in directing the piece.

"*Fix prolonge—for passing a ditch,*" *&c.*

The tangle, or billet, is passed through the lashing-ring, and fastened; it is then its whole length, (26 feet.) In this manœuvre, the trail handspikes are unfixed; and the gunners are ready to disengage the trail, should it be entangled in the passage.

HAVING PASSED THE DITCH, TO EXECUTE A FLANK OR RETREAT FIRE,

The order is given:

"*Shorten prolonge—for flank (or retreat) fire.*"

The gunners shorten the prolonge to the prescribed length.

TO UNFIX THE PROLONGE,

The order is given:

"*Unfix and coil up the prolonge—limber up.*"

The gunner on the right disengages the tangle; and the gunner on the left coils the prolonge round the guides of the limber, and Nos. 7 and 8 move up the limber; when horses are fixed to it, the drivers rein back; the chief of the piece directs the pole toward the trail, so that it may pass over the pintle.

N. B. The gunners must be accustomed to execute with promptness and exactness the following movements, and words of command; they are the most essential in the field:

"*In battery,*" (manœuvring with the prolonge.)

"*In battery,*" (the piece limbered up.)

"*Unlimber, loose, and fix the prolonge,*" (the prolonge must be always cast loose, and fixed, before the piece arrives in line.)

METHOD OF FIXING THE PROLONGE.

The prolonge has, fixed to one of its ends, a key, or tangle; it is 24 feet long from the key to the last ring fixed in the prolonge. At 16 feet from the key, there is fixed another ring to the prolonge, in the following manner: at that distance the prolonge is

untwisted, from which one end is passed, and then through the ring, which confines it in that position. At 8 feet from this, another is fixed, (which, when doubled, gives you the 12 feet ;) the other end of the prolonge is passed between the great sweep-bar and the bridle,* that it may not, when slack, be caught in the wheels ; this end is then passed through the ring which is fixed in the hinder part of the axle of the limber ; so that the last ring of the prolonge is 24 feet from the key, and under the sweep bar.

If there are no rings fixed to the prolonge, a loop made in the cord is substituted. (See it marked 8.) Formerly the prolonge was fixed to two staple rings screwed into the body of the fore axletree ; it was then twisted round the two guides, and fastened by a knot under the sweep-bar ; but in this manner the power was divided, and exposed the limber to be overset.

ORDER OF REPLACING MEN KILLED IN ACTION.

The first man killed is replaced by the 2d of the left, (No. 4,) whose place is supplied by the gunner of the left; the second man killed is replaced by the gunner of the right ; the gunner of the left then performs three duties : his own, that of the gunner of the right, and that of No. 4 ; the third killed, is replaced by the second of the right, (No. 3,) and his duty is performed by the first on the right, (No. 1,) who having loaded, lays his sponge staff against the nut of the wheel, seizes the port-fire, fires, lays the stock against the wheel, and resumes the sponge ; finally, the chief of the gun will perform the duties of gunner ; and the artificer, those of purveyor.

If three men, on either side of the gun, should be killed at the same time ; the 2d on the opposite side, (No. 3 or 4,) would replace the first ; and so on.

MANŒUVRING WITH BRICOLES.

In a town, or in camp, you may be under the necessity of manœuvring with bricoles ; it is, therefore proper to state the number of men necessary, and their duty at the piece.

In the calibers of 6, 9, and 12 pounders, and for the howitz, more

* The bridle, is a rod of iron fixed under the sweep bar, to prevent the prolonge falling.

men are requisite to move the piece, than are necessary merely for the exercise of it; the additional men are auxiliaries, solely to move the piece, and are to be employed in none of the duties relative to its exercise; consequently, their numbers must begin after those of the matrosses, and not be intermixed with them.

There being 2 gunners, and 7 matrosses attached to the 4 pounder, no auxiliaries are necessary.

Two assistants are attached to the 6 pounder, and are denominated 4th matrosses, (or 9 and 10.)

The same number is added to the howitzer.

Four are added to the 9 pounder, as 4th and 5th matrosses, (numbered as 9 and 10, 11 and 12.)

Six are added to the 12 pounder, as 4th, 5th, and 6th matrosses, (numbered 9 and 10, 11 and 12, 13 and 14.)

The piece being limbered up, they are stationed on each side the piece after the matrosses, and towards the pole, one pace distant from each other, provided with short bricoles; the gunners and matrosses attached to the piece have long bricoles, which are hung from left to right, over the pouch belt.

THE PIECE BEING LIMBERED UP;

At the word:

"*Forward.*" (Fig. 21.)

The gunner on the left detaches a handspike, and conveys it to the end of the pole; where, assisted by the gunner on the right, they form two loops with the collar chains, through which the gunner on the left introduces the hand spike across the pole, and horizontally to it; both gunners station themselves behind the handspike, fixed *en galère*,* and are assisted by the third matrosses, (Nos. 7 and 8,) who are stationed outside of them, for the purpose of propelling the piece forward; the first (Nos. 1 and 2) hook on to the washers, the seconds (3 and 4) to the trail hooks; those on the right, with the right hand; those on the left, with the left hand; and lay upon their bricoles; the artificer is on the left of the chase. This position is for 4 and 6 pounders, and for higher calibers.

At the 6 pounders, the fourth (or 9 and 10) form on, and in rear of the first, (Nos. 1 and 2.)

At the howitzer, do. do. do.

* A lever is termed "*engalère*" when it is horizontally placed, forming a right angle with the pole or with a rope.

At the 12 pounders, { the fourth (9 and 10) on do. do.
the fifth (11 and 12) on the second (3 and 4)
the sixth (13 and 14) at the chace.

The artificer, in that case, is where his presence is necessary. At the word

"*March!*"

They all press forward in the direction prescribed, holding the bricole in the hand next the piece.

"*Halt!*"

The gunners, and 3d matrosses, (Nos. 7 and 8,) halt, the others keep their bricoles stretched.

"*To your Posts!*"

The men on the right turn to the left, and unhook their bricoles with the left hand; those on the left perform the same movement in an inverse manner; the gunner of the left replaces the handspike, and they all resume their posts.

The order to *unlimber*, and to *battery*, is executed in the manner prescribed; the auxiliaries follow the limber, and take post on each side of the pole, two paces in rear of its end, and one pace from one another; they assist in supplying the piece, when necessary.

"*Forward!*" (Fig. 22.)

The gunners step to the trail handspikes, seize them with both hands; they are assisted by the artificer, who is stationed between them. The first matrosses (Nos. 1 and 2) hook on at the head of the carriage; the second (3 and 4) at the washer-hook; the men on the right, hook on with the left hand; those on the left, with the right hand; No. 1 carries the sponge staff horizontally, the sponge in front. It is carried perpendicularly against the right shoulder.

With 9 and 12 pounders, the third matrosses (Nos. 7 and 8) are posted at the end of the pole of the limber; they follow the movement of the piece.

At the 6 pounder, and the howitzer, the fourth matrosses (Nos. 9 and 10) double on Nos. 1 and 2.

At the 12 pounder, 9 and 10 double on Nos. 1 and 2; Nos. 11 and 12 on Nos. 3 and 4; and the sixth, (Nos. 13 and 14,) to the supporting handspikes.

At the 9 pounder, the fourth matrosses double on the first, (Nos. 1 and 2;) but the fifth (Nos. 11 and 12) are stationed at the supporting handspikes.

"*March!*"

The men at the handspikes raise the trail; those at the bricoles draw with life, holding them with the hand nearest the piece; they march forward in the direction prescribed; the third matrosses (Nos. 7 and 8) conduct the limber, preserving the necessary distance from the piece.

"*Halt!*"

The trail is lowered to the ground—the bricoles are kept stretched.

"*To your posts!*"

The men face outwards, and unhook those on the right with the right hand; the others with the left, hand; they then resume their posts.

In Retreat. (fig. 23.)

The gunners place themselves at the trail handspikes, which they hold with one hand; the artificer is on the left of the muzzle of the piece; the first matrosses (Nos. 1 and 2) hook on to the washer; the seconds (Nos. 3 and 4) to the trail hooks, (those on the right, hook with the right; those on the left, with the left hand:) the thirds (Nos. 7 and 8) turn the limber to the left about to follow the movements of the piece.

At the 6 pounders, the 9th and 10th double on the 1st and 2d.
Howitzer, do. do. do.
12 pounder, { The 9th and 10th double on 1 and 2, the 11th and 12th double on 3 and 4. The 13th and 14th supporting handspikes.

With the 9 pounder, the 9th and 10th double on 1 and 2, and 11 and 12 are stationed at the cross, or supporting handspikes.*

The orders, "*March*," "*Halt*," are executed as previously explained.

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* By the regulations, 4 men are stationed at the supporting handspikes of a 12 pounder, and but one at the limber, which is not sufficient; there should be two; one must, consequently, be taken from the piece, or the number of auxiliaries must be increased. If the limber can be managed by one person, the artificer must be placed there; and the 3ds with the 6ths will be stationed at supporting handspikes, in the movement to the front; in retreat, the 6ths will leave the 3ds at the supporting handspikes, and will station themselves at the muzzle of the piece, to assist in pushing it back; at the 9 pounder the thirds remain at the handspikes, and the fifths double on the seconds.

At the order

"To your Posts!"

The men on the right unhook with the left hand; and those on the left with the right; the 3d matrosses (7 and 8) turn the limber to the left about, and place the pole in the direction of the piece.

The first (No. 1) places his sponge against the nave of the wheel, to fix his bricole, after which he takes it up.

On Parade.

All the men face to the front; the firsts (Nos. 1 and 2) on a line with the muzzle; the seconds, (3 and 4,) on a line with the nave of the wheel; the gunner on a line with the button of the cascable; the third matrosses, (7 and 8,) on a line with the end of the pole; the auxiliaries or assistants in their rear; the first, or No. 1, carries the sponge in the position of advancing to the front.

TO SUPPORT IN RETREAT.

To support the piece in retreat, and prevent its too rapid descent in going down hill, (being manœuvred with the bricole,)

Order:

Nos. 1 and 2, (or 1, 2, 3, and 4, &c. if more than two are necessary,)

Support in retreat.

Those designated take off the bricole from the shoulder; Nos. 1 and 2 hook on the head hooks, the others to the washer hooks, and hold their bricole straps in their hands, to avoid the danger that might arise from the piece descending too rapidly.

OF THE SCHOOL OF THE BATTLE PIECE.

This school comprehends the movements of a piece of artillery with horses harnessed to, and followed by its caisson. It is served by a detachment of foot, or horse artillery.

A DETACHMENT OF FOOT ARTILLERY, MARCHING BY A FLANK, ARRIVING IN FRONT OF THE PIECE, FRONTS;

Is ordered,

"*To your posts—March!*"

The two ranks take their posts on the right and left of the piece (as stated in the preceding exercise;)* the chief non-commissioned officer commanding the gun, abreast of the driver of the leaders; the artificer, or corporal, in the same position at the caisson. (See pl. 1. No. 2. fig 3.)

In the horse artillery the men are not stationed, on the march,

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* Every man attached to the gun, should be acquainted with all the duties connected with it; but as some do not possess an equal facility with others, if it should be necessary to have those duties pointed out to the men, whether for parade, or otherwise; they will be placed in the ranks as follows, according to the posts they are to be stationed at the gun.

This for the foot artillery:

The chief of the piece on the right of the front rank; on his left, the third matross (No. 7;) then the gunner of the right; next the second matross (No. 3;) then the first (No. 1) in the second rank; the artificer is on the right; on his left the gunner and matrosses corresponding with the front rank, (to wit, Nos. 8, 4, and 2.) So that the company arriving in line, in front of its battery of six pieces, each detachment would take post in front of its gun, by filing from the right. The company arrived in rear of the battery; to wit, in front of the horses; it would break from the left, marching with the left in front, to enable them to arrive without confusion at their posts; finally, if each detachment arrives in line, in front of its piece, the two ranks will move on each side of the piece; at the word:

"*Front rank; from the left, file to the right.*"

"*Rear rank; from the right, file to the left.*"

"*March!*"

But in this case, the front rank should be in inverted order, otherwise the men should not be posted according to their numbers; *(the front rank, however, might countermarch by files from the right, which would produce the same effect.)* The rear rank is properly posted, therefore requires no change. I have observed that it is necessary only to designate the duties for the men belonging to the gun.

on each side of the gun ; they form a detachment in two ranks in rear of the piece ;*

At the order, "*To your posts—March !*" the detachment move up to within one pace of the chace ; and the chief of the gun, abreast the driver of the leaders ; and the artificer at the caisson, as stated above. (In all the wheels, in manœuvring the piece, the order to wheel to the right, or left, implies that side, as relates to the driver.)

"*Forward—March !*"

The drivers urge their horses, and the piece advances, followed by its caisson, the leading horses of which are six or three paces from the muzzle of the piece, (according as it is drawn by six or four horses,)† in the horse artillery, at one pace from the rear rank of the detachment.

TO PREPARE FOR MANŒUVRING, OR FOR BATTLE,

The order is given,

"*Halt !*"

"*Prepare to change trunnion plates !*"

"*Change trunnion plates !*"

"*Unlimber and loose the prolonge !*"

The three last are executed as prescribed, and all resume their posts. In the horse artillery, at the second word of command, the chief of the squad,‡ orders "*to dismount !*" At this command, the men dismount. The numbers, three of each rank, (or matrosses 9 and 10, who are posted in the middle of the rank,) remain on horseback—and take charge of the horses of the others, holding them by the snafle reins, passed over the right and left, (see fig. 20. ;) the men after giving their horses to No. 3, repair

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* In the horse artillery, as the men must retire six paces from the leading horses to dismount, when they are to exercise or manœuvre the piece, their duties having been prescribed to each, they move to their stations at the gun as soon as they dismount. (fig. 20.)

† This distance is for a column of manœuvre. In a column of rout, there is but one pace.

‡ Besides the chief of the gun, there is a chief of squad ; this man is always gunner of the right ; he is on the left of the chief of the piece, in the front rank ; it is he who orders the men to mount, and dismount ; and in all movements, when an union of strength is required ; he also tells the men off by fours (as in the cavalry) previous to the exercise or manœuvres ; No. 3 remains always mounted, to hold the horses of the men of his rank.

to the piece. The men, in dismounting, will confine the bridle by drawing the reins of the curb through the loop, which rests upon the horse's neck; he will pass the end under the cloak strap,* near the left knee, and brings it up at the point where this strap confines the cloak.

When the artificer, or corporal in charge of the caisson, dismounts, he gives his horse to one of the drivers; and the chief of the piece to one of the drivers of the gun.

The above words of command being executed, the officer commanding the detachment, orders:

"*Mount!*"

The detachment mounts and takes post in rear of the pieces. To resume the march, the order is given:

"*Forward!*"

To change the direction to the right or left—(left, for example,) the word is given:†

"*Piece—left wheel—march!*"

The chief of the piece, turns to the left; the driver of the leading horses takes the direction from him; the piece having wheeled into the new direction, the order is given:

"*Forward!*"

The caisson having arrived at the wheeling point, the artificer, who commands it, orders, "*left wheel,*" and follows the direction of the piece.

The right wheel is made *to the right* upon the same principle.

OF WHEELS.

A piece manœuvring with the prolonge, may wheel either upon a *moveable*, or *halted* pivot. In the former, the prolonge is stretched to its extent, and the piece turns in advancing. In the latter case, (or wheeling on a fixed pivot,) with the slack prolonge, the wheel horses back the limber, enter into the new direction, and then advancing to stretch the prolonge, turn the piece upon one of its wheels. Thus, to wheel upon a fixed pivot, the chief of the piece directs the leaders to wheel to the left (or right) about; to move in an opposite and parallel direction to the previous

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* It is understood the cloak of the artillery is fixed on the pomel of the saddle, like the hazzard.

† Each word of command must be preceded by the word of caution, "*attention.*"

one, the wheel horses, at the same time, back the limbers; having arrived on a line with the trail, he wheels to the left (or right,) and, thus, moves in a direction perpendicular to that left.

The caisson cannot turn upon its own ground or upon a halted pivot; it must make a considerable scope, or long turn, describing the segment of a circle. The piece on its limber would pursue the same course to effect its wheel.

WHEELINGS.

Wheeling to the right, or left about, the following word of command is given:

"*Left (or right) about wheel—March!*"*

The leading horses wheel to the left, and immediately to the left again, to complete its left about wheel. To move in a direction opposite, and parallel to the piece, the wheel horses back the limber, as before stated, and in turning the wheel, passes over the prolonge, (otherwise the prolonge engages in the wheel, and embarrasses the manœuvre;) the leaders oblique into the new direction, and then forward.

The drivers must be much practised in this movement; it is important; it should be performed with skill and rapidity, as it is always used in face of an enemy, to change from order of battle, to battery.

Wheelings on a halted pivot being preferable, on account of less space being required, and the movement more promptly executed than on a moveable pivot, or with the extended prolonge, are to be used in all formations. To enable the caisson, or the piece limbered up, to execute the wheel to the left (or right) about, on a moveable pivot: it is wheeled to the left (or right,) it then advances 12 paces; again wheels to the left, or right, and marches parallel to the first direction, to prolong which, oblique to the left (or right.)†

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* All wheels are made to the left, when practicable.

† In wheeling about on a standing pivot, at the command, "*left wheel!*" the men on the right face to the right, and passing the muzzle of the piece, move in rear (1 pace) of the men on the left; No. 2 on a line with the gunner, and so on. At the word "*March,*" the wheel is executed with the slack prolonge; when executed, the men on the left, (who had not moved,) pass round the muzzle, to their posts on the left of the piece. Wheeling on a moveable pivot, or with the extended prolonge, at the word: "*Left about wheel,*" the gunners and matrosses halt; those on the right of the piece pass the gun, and place

In Order of Battle, or in Battery.

The horses of the gun and caisson are towards the enemy; the leading horses of the caisson are 45 paces from the muzzle of the gun; the reverse is the case when the piece and caisson are in battery.*

TO FORM IN BATTERY FROM A HALT.

The following order is given:

"*In Battery!*"

"*Piece and Caisson, left about wheel—March!*"

The piece and caisson are wheeled to the left about; the caisson takes its distance of 45 paces in the rear; the men take their stations at the gun. In the horse artillery the chief of the detachment gives orders—"*Dismount!*"—and the horses are led six paces in rear of the leaders of the piece. (fig. 20.)

TO FORM BATTERY—MARCHING IN LINE.

This movement is executed as above; but in horse artillery, at the words—"*Form Battery!*"—the order—"*trot*"—is added; and the chief of the detachment orders—"*Halt, dismount!*"—and the order—"*Piece and Caisson, left about wheel*"—is not given until the piece is about 30 paces from the detatchments, to the end that their horses may be in their proper position when the wheel is made, and the battery formed. As soon as the men have dismounted, they immediately move up to the ground the piece is to occupy.

NOTE—If the battery was manœuvring with a battalion or squa-

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themselves in rear of the files on its left, as in the preceding case; the wheel completed, the men on the left pass round the muzzle of the gun, to their posts.

The gunner of the right directs and orders the execution of all movements connected with the manœuvre of the piece; he being chief of the detachment, directs the men in their movements.

* Opinion is divided on this point; some say the horses of the caisson should front the rear; others, that they should front the enemy; the first, that you should be always prepared for retreat, when the attack is not affected by it; that by this means the caisson follows all the movements of the piece; wheeling when it wheels, &c. On the other hand, it is urged, that, preparing the caisson for retreat, has the bad effect of discouraging the men and facilitating their flight; that the moment of retreat can be foreseen; and there is always sufficient time for the caisson to perform its wheel to the rear; however, as the latter mode has been the custom, and there are advantages resulting from it, it is preferable to adopt it.

dron, the order to "*Form Battery*," would be given, when the muzzle of the piece is at 20 paces from the line in order of battle; and the order, "*Left about wheel*," until the muzzle of the piece is at least 10 paces from that line; and the "*Halt*," when the limber has passed the line to the rear—(the piece is here supposed with loose prolonge)—drawn by six horses, which gives the distance of 27 paces in length; if there were but 4 horses, 22 paces are allowed.

MARCHING IN OPEN ORDER OF COLUMNS, TO FORM BATTERY.

If you were marching in open order of column, and it became necessary to form battery, the caisson would immediately wheel to the left about, and move to its distance in the rear.

If the piece was on the limbers, it would oblique to the right, that it might not lose its direction in wheeling.

FROM BATTERY TO ADVANCE.

Order:

"*Forward.*"

"*Piece and Caisson left about wheel—march.*"

In the horse artillery, the order, *trot*, is given; and if the distance should be considerable, the commanding officer orders: *Mount!*

FIRING TO THE REAR.

Should the enemy present himself in the rear, and you are in battery to the front, *order:*

"*Fire to the rear!*"

"*Piece and Caisson, left about wheel—march.*"

Both wheel with rapidity, and the caisson advances at a trot, passing the piece 4 paces to the right; as soon as it passes to the rear, the piece continues firing: in the horse artillery, the matrosses who have charge of the horses move round rapidly, in front of the horses of the piece.

FIRING TO THE REAR, ON THE MARCH.

Order:

"*Fire to the rear—halt!*"

The piece halts; the caisson is moved to the front; orders are given, *in action.* In the horse artillery; the chief of the detachment orders: *forward, trot!* they move six paces in front of the leaders of the piece, when the chief orders: *halt, dismount!* they then take post at the gun.

FORMING TO THE LEFT IN LINE.

By wheeling the piece and caisson to the left, provided there is sufficient ground in front to admit the piece advancing to its proper distance; in that case the order is given:

"*Piece and caisson—left wheel—march!*"

The piece wheels to the left, and moves on until it has gained its distance from the caisson; it is then ordered, "*halt!*"

The caisson wheels to the left, and halts when in line, in rear of its piece.

If there should not be ground in front, or you are manœuvring on the flank of a corps, the line of formation of which is not to be passed, the order is given:

"*Left wheel into line!*"

Piece, left } *wheel—march!*
Caisson, right }

At the word: *march*, the piece wheels to the left on a halted pivot, the caisson wheels to the right, to move to the rear; when it has moved about 60 paces to the rear, it wheels to the left, moves on until abreast of the piece, again wheels to the left in the direction of the gun, covering it at the distance of 45 paces. Formations are made to the right by inverse means.

TO FORM IN BATTERY TO THE LEFT.

This formation is accomplished by a simple wheel to the right; it is called inverse order; (it will be explained in the school of the battery;) the order is given:

"*Form battery to the left, by inverse order!*"

Piece, right wheel } *—march!*
Caisson, right oblique }

The piece wheels to the right on a halted pivot, the caisson obliques to the right, and moves to its distance of 45 paces to the rear. In the horse artillery, the chief of the detachment commands: *left half wheel!* then, *right half wheel!* when he is clear of the piece, *forward*, to take his position in front of the leaders, he commands: *right about wheel!* and dismount.

If there should not be space enough on the right to make this movement, or if manœuvring with a corps, as it would be necessary the piece should be in advance of its front, this order would be

given 20 paces before arriving upon the line where the piece is to be formed in battle :

"Form in battery to the left!"

Piece, left / *Caisson, right* } *wheel—march!*

The piece wheels, and moves to the front, when the gun arrives at the distance of 10 paces from the line on which the piece is to form, (suppose the front of a battalion,) order :

Piece, left about wheel—march!

It halts when the limbers have passed its line of formation.*

The caisson obliques to the right, and moves to its distance in the rear. In the horse artillery, the detachment halts, when the piece wheels to the left, and dismount.

Battery may be formed to the right, to fire to the right, by an analogous movement.

MARCHING IN RETREAT.

The march in retreat, only differs from the march to the front in the caisson preceding, instead of following the piece : marching in this manner, if it become necessary immediately to commence the fire, they order : "*halt—in action!*" the piece halts, and the fire commences. In the horse artillery, the officer commands *dismount*, and the horses are led in front of the leaders of the piece.

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* The horses of the limbers must not be in advance of the line of troops; being alarmed at the fire, disorder might ensue; the prolongation of the line of the battalion must pass through the middle of the prolonge.

OF THE MANŒUVRES FOR FIELD ARTILLERY BATTERIES.*

INTRODUCTION.

Before proceeding to lay down the principles of manœuvres, which being equally adapted to the evolutions of infantry and cavalry, might equally suit the foot and horse artillery, it was necessary to solve the important question upon the caissons' position with respect to the field pieces on a march in column; a disposition which is a great object of discussion among the officers of artillery. Some pretend that the pieces must march together, with the caissons in their rear; others, that every piece must be followed by a caisson. Neither of these two dispositions is perfect; both have inconveniences more or less considerable; but the one, according to which every piece is followed by a caisson, which we have adopted, unites more advantages, and is almost generally adhered to, in the field. Many reasons concur to support this disposition:

1. It is more military, since the piece and its caisson being useless when deprived of their reciprocal assistance, ought to be so posted that no obstacle or unforseen event can separate them; and the case where it is indispensable that every caisson should accompany its piece, is so frequent in war, that one must always be in a situation to submit to this rule. In fact, the field piece is commonly drawn along the roads until it reaches the field of battle; and it generally happens that these roads are either narrow, or rendered so by the columns of some other description, which are in motion at the same time, or that these roads offer every moment fresh obstacles, which cannot allow a considerable train of carriages to out march the simple column. Let us suppose that in one of these circumstances it is necessary to bring forward any portion of a battery,

* These manœuvres are extracted from those which I wrote in 1810, for the artillery of the imperial guard, in common with three other officers of the same corps, (Messrs. Lafond, Bitsh, Mantel,) and which have been printed, and studied in France.

the caissons, if all united, will not be able to follow their pieces. Even then, admitting the ground was favourable, and this portion to be brought forward with rapidity in front of the column, in order to protect its deployment, as is so often the case in the field, either the movement of the pieces would be retarded, or the caissons would not arrive until the ammunition chest was emptied. Let a bridge break after the passage of the pieces, the caissons will remain on the other side, and not be able, perhaps, to rejoin the pieces but very late. Moreover, if the field pieces are divided in their march, in order to take different positions, every caisson not being in the practice of following immediately its piece, and not having it in sight, will lose it; the embarassments which always increase at the approach of the enemy, will multiply, and that piece, entirely separated from its caisson, will reach the field of battle without ammunition, or with a caisson of a different caliber, if the battery, as it is almost always the case, consists of pieces of different descriptions, (guns and howitzers.)

It is therefore evident, that in all these circumstances, which are the most common in the field, the ammunition chest will not be able to remedy the disadvantage of separating the caissons from their pieces in column, and that the mode of intercalation must absolutely be adopted.

2. This disposition is also more favourable for the evolutions; because every caisson being in the rear of its piece, a column by sections, (which is our column of manœuvre,) occupies exactly the same space, as in order of battle, and can consequently immediately face to either flank; a movement which a column, composed of sections of pieces, and then followed by their caissons, cannot do, on the same ground, and without some previous movements which are impracticable, when the artillery manœuvres surrounded by troops.

3. The artificers who direct the caissons, direct them with much more facility, when they see that their movements have no other end but to place their caisson exactly in the rear of the piece, at the place indicated by their position, whether in column, battle, or battery.

To this mode of intercalation, a single objection may be made; it is, that a column, where every piece is not immediately followed by its caisson, will be sooner deployed; and that the gunners will have less space to run over, than in the case of the disposition

which we have adopted. We agree, that in a deployment to the front, according to our method, the pieces in the rear will arrive a little later on the line ; this delay of the third section, for example, will be equal to the necessary time to travel two lengths of caissons, with their intervals ; that is, less than half a minute. But the two lines which really constitute a battery, will not be sooner formed in one case than in the other. This reason is, therefore, of very little import, when compared with the contrary ones, which we have given here above.

We have subjected ourselves not to invert the order of the pieces in batteries, and the respective order of the batteries among themselves. Experience has proved to us, that a confusion, sometimes difficult to be remedied, was often the result of a contrary usage. When that inversion may be useful, the natural order must be resumed, as soon as possible.

OF THE SCHOOL FOR FIELD BATTERIES.

GENERAL PRINCIPLES.

A battery of artillery of six pieces will be served by a company of artillery, whether foot or mounted.

Six caissons attend the battery, and manœuvre with it; the remaining supply of ammunition, &c. will constitute a reserve under the charge of a conductor of artillery, or a non-commissioned officer.

The battery shall be divided into three sections; each section will consist of two pieces, and two caissons.

It is also to be divided into two half batteries, each comprising three pieces, and three caissons.

The captain commands the battery.

Three subalterns, or, in case of deficiency, the senior non-commissioned officers, shall command the sections. The first under the command of the highest in grade, the third by the second, and the second by the junior in grade.

The officer of the first section commands the first half battery; the second half battery is commanded by the officer commanding the third section. The officer of the second section becoming attached to the first.

A sergeant (or corporal) shall be attached to each piece, he has charge of it, and directs it in all its movements.

The officer commanding the company of the train attached to the battery, shall command the line of caissons.

The artificer attached to each caisson, will direct its movements.

Two non-commissioned officers of the train, will act as guides and markers; these duties being useless in front of the enemy, they will, in that case, be otherwise employed, (viz. with the sections of caissons.)

In the foot artillery, the men attached to the gun, march in file on each side of the piece, preserving their posts agreeable to the regulations.

In the horse artillery they form in two ranks in rear of the piece, as it is said in the school of the piece.

THE BATTERY WHEN IN LINE, must be numbered, both pieces and caissons, from the right, and these numbers will be designated by their numbers in every movement, and these numbers, except in extraordinary cases, must not be inverted.

Sections, and half batteries, shall be numbered in the same manner.

In wheeling, the right and left is taken in regard to the drivers, and not to the piece.

The dressing will be taken up on the driver of the wheel horses; for parade, the dressing may be more correct upon the axle-trees of the pieces. In that case, the officer commands: *on such a piece—dress!* As in the infantry, the guide is always on the pivot flank.

Whether in battery, or in line, the horses of the caissons will front, as those of the pieces.

The cautionary word, *attention*, is given by the captain, and repeated by no other person.

Officers commanding sections, will repeat all orders relative to their sections, as well as the orders of execution, when the battery is in column.

The officer of the train will repeat the orders applicable to the caissons.

IN COLUMN, each caisson will follow its piece when moving to the front, or precede it in retreat.

In the manœuvres, its movements will be regulated by those of the piece; and by the orders of the officer of the train.

In manœuvring, the battery will be formed in line, or in column of sections.

Column of pieces, or single file, is never to be used but in passing a defile, (which will not admit two pieces in front,) or on a march.

Wheeling about must always be to the left, and always by pieces.

A caisson, or piece, passing each other, the movement must always be to the right.

Manœuvring with the prolonge must be constantly used in presence of any enemy; therefore, in all the exercises of firing, that object must be considered. When, however, the officer com-

manding the battery is certain that it will not be necessary to form in battery, but merely to correspond his movements with those of the troops with which he is acting, he will direct the guns to be placed on the limbers, to spare the horses, and preserve the prolonge.

The piece, with six horses, and its prolonge extended, occupies fifty-four feet, and this distance must be preserved between the pieces in line; and-forty four feet with four horses.

FORMATION OF THE COMPANY IN COLUMN, IN LINE, IN BATTERY, AND FOR PARADE.

ORDER OF MARCH IN COLUMN OF PIECES, THE RIGHT IN FRONT.

The captain is posted abreast the centre of the column on the left flank; the officer of the train opposite to him, on the reverse flank.

The officers commanding sections, are on the left flank, four paces from it, in the centre; except the officer of the first section, who marches at the head of the column.

The non-commissioned officers commanding the piece, or caisson, marches on a line with the driver of the leadiug horses.

The men, if mounted, one pace in rear of the piece. The leading horses of the caissons, one pace in rear of the gunners. In the foot artillery, one pace in rear of the piece.

The two guides march at the head, in rear of the column; the first, one pace on the left of the driver of the leaders of the first piece—the other, the same distance from the rear caisson.

The drums and trumpets, six paces in front of the head of the column.

The non-commissioned officers of the train are distributed along the reverse flank of the column.

COLUMN OF SECTIONS, RIGHT IN FRONT. (pl. 1. No. 2. fig. 3.)

The captain is posted in the centre of the column, eight paces from the pivot flank, or in any other position where he can best observe the execution of the movements, and have his orders best understood

The commandant of the caissons, the same distance, and same position, on the reverse flank.

The officer commanding the first section, at the head of the centre of his section, two paces in advance of the leading horses.

The officers of the other sections, also, posted in the centre of their sections; but in a line with the drivers of the leading horses.

The non-commissioned officers commanding pieces, abreast the driver of the leading horses. (In horse artillery, the chiefs of the two pieces of the head of the column, are allowed commonly to march one step in front of the leading horses.)

The artificers abreast the same driver of the caissons.

The gunners, one pace in rear of the piece.

The guides at the head of the column, on a line with the horses at the head of the column, two paces from the near and off horses. One, on the pivot flank, is charged with the direction; the other, with preserving the distance between the files. (In the field, the chiefs of the pieces are to be considered as guides.)

Drummers and trumpets, six paces in front of the officer leading the column.

In the foot artillery, the distance between the carriages is six paces, when the pieces have six horses; but when they have but four, three paces will suffice.

In the horse artillery, the piece is one pace from the caisson; and this, one pace from the squad.

In this manner, supposing the pieces to which the prolonge is fixed, having their team of six, and the caissons theirs of four horses, the column will be from 105 to 110 yards long; but, if the pieces have only four horses, the column will be but from 86 to 100 yards long. It is to be observed, that if the caissons had a team of six horses, as the pieces, the artillery column would be about 12 yards longer than when in battle.

Fig. 3, represents a battery in column; the two first sections of which are foot, and the third horse artillery.

The column in retreat, the officers of sections and the guides will assume, relative to the caissons, the same positions they occupied near the pieces, when the column advances.

Observation.—The left in front, the position of the officers, &c. on the flanks, is changed.

IN LINE. (pl. 1, No. 2, fig. 1.)

The captain in front of the centre, twelve paces from the leading horses.

Officers commanding sections, six paces in front of the centre of their sections.

Commandants of guns, one pace in advance.*

The squad of gunners, four paces in rear of the guns.

The guides, on the flanks of the battery, in a line with, and two paces from the drivers of the wheel horses.

The caissons in rear of their guns, 45 paces from the leaders to the piece.

The officer of the train, twelve paces in advance of the centre of the caissons.

The artificers, one pace in advance of the caissons.

The drums or trumpets, on the right, four paces in rear of, and four paces on the right of the gun.

The formation, retreating in line, is the same as advancing, excepting that the men of the horse artillery change their position, from the rear of the piece to four paces in advance of the commandant of the gun.

FORMATION IN BATTERY. (pl. 1. No. 2. fig. 2.)

The captain will station himself where he can be best heard, and can observe the fire; but, commonly, in the centre of the battery, on a line with the limbers.

Officers of sections, in the centre of the section, in a line with the limbers.

Commandants of pieces, opposite to them; half way between the limber and the handspikes.

The gunners, at their stations.

The caissons, in rear of their pieces, 45 paces from the leaders of the guns.

The horses of the men, facing the enemy; six paces in front of the horses of the limbers.

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* It is more essential, when marching in line, to preserve the correct distance between the guns, than attending strictly to the alignment. It is on this account that the non-commissioned officers are in front of the leading horses. The dress is corrected when the line halts.

The officer of train, six paces in front of the centre of the caissons, facing the horses, to prevent a retreat.

The artificers, near the caissons, during the fire.

The drums and trumpets, four paces on the right of the battery, on the line of the horses of the gunners. During the fire, a trumpet will attend the commanding officer.

The guides will occupy the same position which they had in order of battle.

Fg. 2. represents a foot artillery company, formed in battery.

REVIEWS AND PARADES.

The battery will be in order of battle.

The pieces on the limbers, twenty paces interval between them.

The gunners in two ranks, twelve paces from the guns in rear, to enable the reviewing officer to pass between them and the pieces.

Commandants of pieces, on the right of their squads.

The officers, artificers, and guides, occupy their stations in line.

Trumpets, four paces from the right, in line with the gunners; and the trumpets of the train, in line with the leading horses of the caissons.

MARCHING PAST.

Orders being given to defile; if in line, the gunners close up to four paces from the piece; and the line of caissons, fifteen paces from that of the pieces.

The trumpets are six paces in front of the commanding officer, who, in column, is abreast of the officer of the front section, and on the side next the reviewing officer. The drums on the reverse flank of the battery.

If in marching past in line, there should not be sufficient space to allow twenty paces between the guns, they will be closed, so that the men form a compact line. The wings will take care to preserve their distance of four paces from their guns, and the step will be taken from the guide.

NOTE.

The space which a piece occupies with the prolonge, extended and harnessed with 6 horses, is - - - 27 paces, or 54 feet.

The space do. do. with 4 horses, - 22 do.

Caisson,	do.	do.	4 horses,	- -	16 do.
do.	do.	do.	6 horses,	- -	21 do.
From the muzzle to the driver of the wheel horses,					15 do.
Space which a horse has in the traces,				- -	5 do.
	do.	do.	in line,	- -	4 do.
The space a piece occupies on its limber, with 6 horses,					21 do.

THE SCHOOL OF THE BATTERY COMPRISES THE FOLLOWING MANŒUVRES :

PREPARATORY MOVEMENTS.
- To break into column of pieces, before leaving the park.
- Fix prolonge, and march out.

MANŒUVRES.

1. Marching in column of pieces ; form sections ; and change direction.
2. Form line to the front ; form battery.
3. Break into column of sections.
4. Form battery to the front.
5. Form line to the left.
6. Form in battery to the left.
7. Form line on the right.
8. Form in battery on the right.
9. March in line, in retreat ; and change direction, &c.
10. Form line ; form battery.
11. Passing obstacles.
12. Passing a defile.
13. Change front from line ; on the right, or left, wings.
14. Change front from battery ; to direct the fire to either flank.
15. Firing from either flank ; firing in retreat, by half battery ; 3d. Firing to the rear.

PREPARATORY MOVEMENTS.
1. Coil up the prolonge to return to park.
2. Break into column of pieces.
3. Park ; battery.

FIRST MOVEMENT.

THE BATTERY BEING PARKED IN ORDER OF BATTLE, TO THE FRONT, FORM COLUMN OF PIECES, BY ADVANCING FROM THE RIGHT.

The Captain commands :

1. *Attention.*
2. *Form column on the right—advancing.*
3. *March.*

At the second word of command, the officer of the first section orders:

No. 1—*Forward.*

At the third command, repeated by the officers of the first section, the first piece, followed by its caisson, moves forward. As soon as the hind wheels of the first caisson are a-breast of the leading horses of the second piece, the officer of the section orders this piece to move forward, followed by its caisson ; it obliques to the right to enter the column.

The other pieces successively break off in the same manner, ordered by the officers of the respective sections, and oblique as much as possible to enter the column.

2d CASE : BREAKING INTO COLUMN TO THE RIGHT.

The Captain orders :

By pieces, right wheel, in column.

March.

At the second word of command, the officer of the first section commands :

No. 1—*Right wheel.*

At the word, *March*, repeated by the officer of the first section, No. 1 executes its wheel in advancing. The caisson advances ; wheels on the same ground, and follows its piece. This caisson having made half its wheel, the section officer orders No. 2 to wheel ; the other pieces wheel successively in the same manner, ordered by the officers of their sections.

The movement may be made to the left in the same manner.

3d CASE—BREAKING INTO COLUMN, ON RETREAT, BY PIECES FROM THE LEFT.

(Being parked in battle order in front,) the captain commands:

1. *Attention.*
2. *Retreat in column from the left.*
3. *March.*

At the second word of command, the officer of the train orders:

Sixth caisson—left about wheel.

The officer of the third section:

No. 6—*Left about wheel.*

The word, *march*, repeated by the officers commanding the train, and the third section.

The sixth caisson executes its wheel, and moves forward; the sixth piece immediately follows.

The fifth caisson wheels to the left, as soon as the sixth piece passes it, it turns in rear of the sixth piece, and takes its place in column, the fifth piece immediately follows its caisson, manœuvring in the same manner.

The other caissons and pieces move in the same way.

The gunners are in front of the leaders of their guns.

OBSERVATIONS. The retreating column must not be formed upon the first piece, because the caissons would be obliged to wheel to the right about, and, besides, to resume the advance, one would have the left in front.

4th CASE—BREAKING INTO COLUMN, FACING TO THE REAR.

If the battery was parked facing to the rear, to resume the march to the front,

The captain commands:

1. *Attention.*
2. *On No.* 1—*form column facing to the rear.*
3. *March.*

At the second word of command, the officer of the first section orders:

No. 1—*right about wheel;* and when it enters the direction—*forward!* the caisson follows its movement; the other pieces and

caissons break off, and file into the direction in the same manner, by orders from the officers of the sections.

The column would be formed to either flank, by analogous means.

Note.—If in the park, there is not space enough to form the detachments before the guns; they must be formed out of the park, on the flank upon which the column is to be formed, and parallel to its direction; the detachments will file in rear of their respective pieces, as they pass; and the artificers to the caissons, by orders of the officers of the several sections.

SECOND MOVEMENT.

HALT THE COLUMN—UNLIMBER—FIX THE UROLONGE—AND RESUME THE MARCH.

The captain orders:

1. *Attention.*
2. *Column.*
3. *Halt.*
4. *Unlimber, and fix the prolonges.*

The officers of sections repeating the third word of command, the pieces and caissons *halt.*

The fourth word of command, repeated by the officers of sections, will be executed agreeably to regulations. The non-commissioned officers commanding pieces, will direct the leading horses to incline to the left.

(*In the horse artillery,*) the officer commanding the squad, orders "*dismount,*" and "*mount,*" when the prolonge is fixed. The usual length of the prolonge *doubled,* is 12 feet. The prolonge must always be fixed for manœuvre, before you arrive on the field.

The prolonges being fixed, the captain orders:

1. *Attention.*
2. *Column forward.*
3. *March.*

Which being repeated by the officers of sections, the column moves forward.

FIRST MANŒUVRE.

TO FORM SECTIONS.*

The column, the right in front, moving forward to form sections.

Captain orders :

1. *Attention.*
2. *Form sections.*
3. *March.*

At the second word of command, the officer of the first section orders :

No. 1, forward—No. 2, oblique to the left. (*In the horse artillery*, the officers order, "*trot.*") At the word "*march,*" repeated by the officers of the sections, the piece No. 2. is conducted by its officer, and followed by its caisson, 27 paces to the left of No. 1 ;† No. 3 being on the ground where the first section was formed, the officer forms it, in the same manner, and by the same words of command.

In the foot artillery, the even numbers lengthen the step, and the head of the column shortens it, to enable the sections in the rear, to form, and close to their distance.

(*In the horse artillery,*) the head of the column does not diminish its gait; the rear sections, by order of their officers, close up to their distance at a trot.

Sections being formed, the captain orders :

Guide to the left.

The guide, from the rear of the column, moves to the front, and posts himself in front of the left piece of the column.

A column, the left in front, the sections are formed by the odd numbers, obliquing to the right.

To break off sections, (see the return to the park at the conclusion.)

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* A column of pieces is not a column of manœuvre; it occupies too much ground.

Arriving near the battle, or manœuvring ground, they take the prolonge.

† We take notice, once more, that the piece is supposed here to have a team of six horses; if it were of four only, it would move then but 22 paces from the other piece of its section.

2d CASE—A COLUMN ON THE MARCH, THE RIGHT IN FRONT TO CHANGE DIRECTION.

The captain orders:

Head of the column will change direction to right or left.

Immediately the officer of the first section commands:

Section, right or left wheel.

The pivot describes an arc, so as to unmask the point of wheeling.

In the foot artillery, this piece shortens the step.

(*In the horse artillery,*) the wheeling flank moves at a trot; this is a general principle, in all wheelings on a moveable pivot.

The wheel being finished, the section officer orders:" *forward;* and the section resumes its march to the front.

The officers of the other sections wheel them on the same ground, the first section wheeled upon.

SECOND MANŒUVRE.

TO FORM LINE TO THE FRONT.

The column, moving the right in front, by sections.

After having placed the two markers, who are to determine the line of formation; one at the point the wing is to rest on, the other at 27 paces distant; at 40 paces before the column arrives on the line, the captain commands:

1. *Attention.*
2. *Form line to the front—guide to the right.*
3. *March.*

At the second word of command, (the guide being on the right,) the officer of the front section orders:

Section, forward.

The other officers:

Section, left oblique.

At the word "*March!*" repeated by the officers of sections, the leading section moves up to the markers, and halts; when the drivers of the wheel horses are abreast of them, leaving the markers on the right.

The other sections oblique to the left.

When the third piece has gained its distance of 27 paces, the officer of its section orders:

Forward.

And when the wheel horses are at four paces from the line, he orders:

Section, halt—right, dress.

On which the commandant of each piece advances on the line, dresses himself on the markers; and then dresses up his piece. The third section moves into line, in the same manner; and dresses on the second.

The sections of caissons oblique, with their pieces; the first section having advanced 16 paces, the officer of the train orders:

First section, halt—right, dress.

The other sections halt four paces from the line, and dress up on the right.

The line being formed, the guide of the left resumes his place in line, passing in rear of the pieces. (The guides resume their places, without orders, as soon as the movements are performed.)

2d CASE—TO FORM BATTERY,

From column of sections, on a march, right in front.

The captain commands:

1. *Attention.*
2. *Form Battery.*
3. *March.*

At the second command, the section officer orders:

Section, forward.

Officers of the other sections, order:

Section, left oblique.

(In the horse artillery, they add: *Trot.*)

At the word "*March,*" repeated by the officers commanding sections, who also orders guide to the right; the first section continues its march to the front; the other sections oblique, until they have gained their distance to the left; they are directed by their officers to move forward, and form on the first section.

The head of the column, in the foot artillery, shortens the step; the other sections increase it. This is general in all deployments.

(*In the horse Artillery,*) as the sections come into line, their officer orders, "*Walk—March!*" and they dress on the first section.

The battery being formed, the captain orders :

Guide to the left, (or right.)

At this order, the foot artillery resumes the ordinary step.

The caissons follow their pieces; the first shortens its step until it has the distance of 45 paces from the gun. The other sections of caissons dress upon the first, as they come into line.

THIRD MANŒUVRE.

TO BREAK OFF THE BATTERY.

In the foot artillery, the captain orders :

1. *Attention.*
2. *Sections, break off.*
3. *March.*

At the order, "*sections, break off,*" the officer of the first section commands :

Section—forward.

The other officers command :

Section—right oblique.

(*For the horse artillery,*) the captain commands :

1. *Attention.*
2. *Sections, break off—head of column—trot.*
3. *March.*

The officer of the first section orders :

Section—forward—trot.

The other sections, the officers command :

Section—right oblique.

The gunners close to one pace from the piece.

At the order, "*sections, break off,*" the officer of the train commands :

Caissons—forward—trot—march.

The caissons then move up, and close on their pieces ; (closing the second on the first line, is general in the formation of columns.)

At the word "*March,*" repeated by the chiefs of sections, and which is given when the second line has advanced within 20 paces of the first ; the first section moves forward ; the second and third led by their officers, and followed by their caissons, oblique to the right, and take their place in column.

The first section of the foot artillery, lengthens the rope.

(In the horse artillery,) when the movement is completed, the captain commands :

Walk—march.

The step is taken from the leading section, and the distance carefully preserved.

The guide on the left, moves in front of the left file of the column to direct it.

NOTE.—To march to the right, the second command would be, "*Sections—right wheel into column.* To retreat, in column, the second command would be, "*On the third section, retreat in column;*" and the officers of sections would command: pieces and caissons left about wheel.

FOURTH MANŒUVRE.

FORM IN BATTERY TO THE FRONT, (FROM COLUMN OF SECTIONS.)

The two markers being posted facing the column, and the head of it having advanced 30 paces from them,*

The captain orders :

1. *Attention.*
2. *Form in battery, to the front—Guide to the right.*
3. *March.*

At the second word of command, the direction is taken from the guide on the right, and the officer of the 1st section orders :

Section forward.

The other officer order :

Sections—left oblique.

At the word, *march*, repeated by the officers of the sections, the first section moves forward, each piece leaving the marker to the left; and having passed the line 5 paces, its officer orders :

By pieces, left about, wheel—march.

The wheel is performed ; the prolonge slack ; the pieces move up on the line ; and the drivers of the wheel horses being abreast of the markers, (or the captain who is on the line,) the officer orders :

Section—halt.

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* As markers cannot be used in front of an enemy, the line is understood to be that formed by the drivers of the wheel horses, and not that of the muzzles of the guns.

The other sections perform the same movement, and having wheeled, they move and dress upon the first section.

The caissons of the first section advance 15 paces, halt, and dress by the right, by order of the officer of the train; the other caissons move up successively, and dress by the right. (*In the horse artillery*) the movements are made at a trot; the gunners halt 20 paces from the line, dismount and advance rapidly upon the ground, to wait the arrival of their piece on the line.

The same manœuvre is executed, the left in front, and in the same manner, substituting the word "left," for "right," and reciprocally.

FIFTH MANŒUVRE.

FORMING LINE TO THE LEFT.

The column of sections being halted, right in front, the captain orders:

1. *Attention.*
2. *Left wheel.*
3. *March.*

At the order, *left wheel!* the guide on the right moves rapidly 15 paces beyond the left, abreast of the leaders of the second piece; the officers of sections order:

Section—left wheel.

The officer of the train commands:

By caissons—right wheel.

At the word, *march!* repeated by the officers of the sections and the train, each section of pieces wheels to the left, on a halted pivot, and is halted by its officers by the order:

Section—halt—right—dress.

The caissons wheel to the right, unmask the guns, and march in three columns, distinct and parallel to each other. When the head of each has advanced 20 paces, the officer commands:

Head of columns—left wheel—march.

When each caisson arrives nearly on a line with its piece, the officer of the train orders:

By caissons—left wheel—march—halt—right—dress.

At this last order, the right caisson takes its distance in rear of

its gun, and the others dress upon it, covering their respective guns.*

SIXTH MANŒUVRE.

TO FORM TO THE LEFT IN BATTERY.

Being a column, to fire to the left, the most prompt means would be, "to wheel immediately to the right;" but this movement inverts the original order; and is, therefore, termed by inversion. The captain commands:

1. *Attention.*
2. *Form to the left in battery—"by inversion."*
3. *March.*

At the second word of command, the officers of sections order:

"Section—right wheel."

The officer of the train, orders:

"Caissons—right oblique—trot."

At the word *march*, the sections wheel on a halted pivot, and dress on the left.

The caissons leave their pieces on the left, in passing them, and take their position in battery.

(*In the horse artillery,*) the detachment moves in front of the horses of their piece, leaving it on the right.

To resume the original order in column, the captain commands:

1. *Attention.*
2. *Sections—left wheel—into column.*
3. *March.*

At the second word of command, the officers of sections order:

Sections—left wheel.

The officer of the train, commands:

"Caissons—odd numbers—left wheel; even numbers—left about wheel—march."

At the word "*march,*" the sections wheel and move in the new direction.

The sections of caissons in three columns take their direction to obtain their position, in rear of their pieces; where, having arrived, the officer of the train orders:

"By Caisson—to the right wheel—march."

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* If the column were in motion, the pieces on the pivot flank would halt at the word "*march.*"

SEVENTH MANŒUVRE.

FORM LINE ON THE RIGHT.

Column of sections, right in front; on the march.

The two markers being posted 20 paces from the right flank, and parallel to its direction, the captain commands:

1. *Attention.*
2. *On the right form line—guide to the right.*
3. *March.*

The word march is given when the head of the column has nearly arrived abreast of the first marker; the officer of the first section orders:

Right wheel—forward.

Section—halt—right—dress.

The section is halted and dressed when the wheel horses are in line with the markers.

The officer of the train, orders:

First section—by caissons—left wheel—march.

Each caisson wheels in advancing, and having gained the distance of 15 paces, he again orders:

Head of the column—right wheel—march—by caisson right wheel—march—halt—right dress.

The caissons are placed in rear of their pieces. During this time, the second section continues to advance, followed by its caissons. When the third piece has arrived opposite to the point it is to occupy in line, the officer of the second section commands:

Right wheel.

This section moves up into line, as the first had done, and dresses on the right, in the manner prescribed.

The second section of caisson takes its position, by orders from the officer of the train, by similar movements as the first.

EIGHTH MANŒUVRE.

TO FORM ON THE RIGHT IN BATTERY.

The markers are posted facing the column, 15 paces from the right flank; the captain orders:

1. *Attention.*
2. *On the right in battery—guide to the right.*
3. *March.*

The sections deploy successively as in the preceding manœuvre; they pass the line; and at the distance of 45 paces, wheel to the left about, "*halt—left dress,*" by orders from their respective commanders.

The caissons perform the same movements, and take their positions successively as forming on the right in line.

As soon as the even numbers have wheeled to the left, the officer commands:

Head of columns right wheel—march—by caissons left wheel—march —halt—left dress.

Second Case. Were it necessary to command the fire to the right, without waiting for the regular mode of formation, the captain would order:

1. *Attention.*
2. *By inversion, form in battery to the right.*
3. *March.*

At the word, *march*, the sections would wheel to the left.

The caissons would oblique to the left, leaving their pieces to the right, and take their position in battery.

The detachments would pass to the right of their pieces, and take their position between them and the caissons.

To RESUME THE NATURAL ORDER, the captain commands:

1. *Attention.*
2. *Sections right—wheel into column.*
3. *March.*

The pieces wheel to the right, the even numbered caissons to the right, the odd numbered to the left about. The three columns of caissons, in this manner, resume their positions in rear of their guns, where, having arrived, they wheel to the left.

NINTH MANŒUVRE.

MARCHING IN LINE.

The battery being halted,

To advance in line, the captain commands:

1. *Attention.*
2. *Battery forward—guide to the left, (or right.)*
3. *March.*

At the second word of command, the guide, directed to lead, advances 12 paces in front of the commandant of the piece, on his flank, and faces the point of direction.

At the word: *march*, the battery moves forward, the commandant of the piece in the rear of the guide, takes care to march in his line of direction, in preserving correctly the distance of 12 paces. The other officers of pieces preserve their intervals, and dress upon the officer of the directing flank. The officers of sections dress upon each other in the same manner. The line of caissons follows the movement of their pieces, and preserves the distance of 45 paces from them.

Observation. If the ground compelled a dimunition of the intervals between the pieces, the captain would command:

1. *Attention.*
2. *On — piece (so many paces,) close the intervals.*
3. *March.*

At the word: *march.* the pieces close obliquely on the mentioned piece to the distance directed.

The ground enabling you to resume the true distance, the captain orders:

1. *Attention.*
2. *Resume intervals from piece.*
3. *March.*

At the word: *march*, each piece obliques to the flank, until it has gained its distance.

The caissons arrived at the same point; perform the same movement.

Note—If after having closed the intervals, there should not be sufficient distance to wheel the battery to the left about, by piece, and if it should be necessary to do so, the captain would *halt* the line, and order:

1. *Attention.*
2. *Even number pieces and caissons—forward.*
3. *March.*

At the word: *march*, the named pieces and caissons move out, and having passed the odd numbers, at wheeling distance, the captain orders:

By pieces and caissons—left about wheel—march!

Both lines wheel, and the even numbered pieces and caissons resume their places.

2d MOVEMENT. TO MOVE IN RETREAT.

The captain commands:

1. *Attention.*
2. *Retreat battery.*

3d. *March.*

At the second order, the officers of sections command:

By pieces—left about wheel.

The officer of the train commands:

By caissons—left about wheel.

At the word: *march*, repeated by the officers of sections and the train, the pieces and caissons execute the movement, which being finished, the order is given by the officers of section and of the train:

Forward.

Immediately after, the captain commands:

Guides—to the right (or left.)

The one, directed by the captain, advances 12 paces in front of the caisson on his flank, and the battery marches in retreat, upon the same principles as moving to the front.

3d MOVEMENT, TO CHANGE THE DIRECTION OF THE BATTERY MARCHING TO THE FRONT.

The captains commands:

1. *Attention.*
2. *To the right (or left)—turn.*

On which the line of pieces executes its change of direction. Attention must be paid to preserve the intervals from the *pivot*, and the dress from the wheeling flank.

The pivot gains ground in wheeling, and the pace is shortened from that to the wheeling flank, which increases its gait.

(*In the horse artillery*) the wheeling flank moves at a trot.

The movement finished; the captain orders:

Forward.

On which all the pieces resume the march to the front, and the ordinary pace.

The line of caissons moves up to the point on which the pieces turned, and performs the movement, by order of the officer of the train.

4th MOVEMENT—TO HALT THE LINE AND DRESS IT.

The captain commands "*halt*," and the first section is advanced 20 paces. The drivers of the wheel horses, being dressed on the line of the new direction he means to give the battery, he orders : "*By sections on the right—dress*". The officer of each section successively gives the following order : "*Section, forward —guide to the right—march.*" When the section is 4 paces from the new line, he orders : "*Halt—right—dress.*" The men are then dressed up ; the officer of the train having formed the first section of caissons in rear of their pieces, orders : "*Caissons, forward—guide right—march ;* then *halt—right—dress.*

TENTH MANŒUVRE.

FROM LINE FORM IN BATTERY.

The captain commands :

1. *Attention.*
2. *In battery.*
3. *March.*

At the order : *in battery*, the officers of sections commands :

By pieces—left about—wheel.

The officer of the train commands :

Caissons—left about wheel.

The non-commissioned officer commanding the squad in the horse artillery, orders :

Halt—dismount.

The battery having advanced 30 paces from the gunners, the captain commands : *march*, which being repeated by the officers of sections, the pieces wheel to the left about, and commence the fire ; the caissons close to their distance, and wheel to the left about.

OBSERVATION.—If the battery were halted, the movement would be in the same manner, and the horses of the gunners would be reined back, to their position in battery.

ELEVENTH MANŒUVRE.

PASSAGE OF OBSTACLES.

First marching in line and an obstacle is presented.

The battery arriving near the obstacle, the captain orders:

Piece (or section) break off.

The officer of the section orders:

Piece, right (or left) wheel—march.

On which the piece is wheeled, and moves in rear of the other piece of its section.

The caisson, when it arrives at the obstacle, performs the same movement, by order of the officer of the train.

If a section meets with an obstacle, the officer of the named section, orders:

By pieces to the left (or right) wheel—march.

When the pieces have arrived in rear of those of the section they are to double on, the officer orders:

By pieces right (or left) wheel—march.

The caissons execute the same movement, as they arrive on the ground.

Having passed the obstacle, to form battery, the captain orders:

Piece (or section) move into line.

The officer of the section, then orders:

Piece, (or section,) right (or left) oblique—march.

The piece (or section) moves into line, increasing the step. (*In the horse artillery*) they move at a trot.

If one of the wings should meet with an obstacle, it would move in rear of the centre section; if the obstacle were to the centre, it would form in rear of the right.

To pass obstacles in retreat, the same means are used, as in passing them to the front.

TWELFTH MANŒUVRE.

PASSING DEFILE.

The defile may be passed to the front, in the same manner prescribed for breaking into column of pieces, or sections.

The defile is passed in the same manner, in retreat; the caisson preceding the pieces; if a part of the battery should not be com-

pelled to cover, and support the retreat of the other. But if obliged to effect the passage under the fire of the enemy, the captain halts the battery at the entrance of the defile, and commences the fire. He then commands :

Piece—pass defile to the rear—march.

At the second word of command, the named piece or pieces, cease firing, and the officer commanding the sections, orders :

Such or such pieces, "retreat in column."

The caissons commence their movement in retreat. When the pieces have passed the defile, they are formed in battery, and, if necessary, the fire is continued.

THIRTEENTH MANŒUVRE.

CHANGING FRONT TO THE RIGHT OR LEFT.

Being in line, to change front to the right.

The two markers being posted where the first section is to form, the captain commands :

1. *Attention.*
2. *Change front to the right, on the first piece.*
3. *March.*

At the second order, the officer of the first section commands .

No. 1, right wheel—No. 2, right oblique.

The officers of the other sections command :

Pieces right oblique.

Officer of the train :

By caissons, left wheel.

The order *march*, given, and repeated by the officers of sections, and train ; the first piece wheels on a halted pivot, the second moves up to the left of its marker.

The other sections, led by their officers, move into line, (as prescribed,) and dress by the right.

The caissons, except the sixth, wheel to the left ; this moves forward, and the others move on, and wheel on the ground which it ocoupied ; they must be careful to preserve the distance of 12 paces between them, when they arrive in rear ; and the officer of the train orders :

By caisson, right wheel—march—forward—guide right—halt—right dress.

Changing front to the left, the same movement is required, substituting the word *left*, for *right*, and *vice versa*.

2d CASE—CHANGE OF FRONT ON THE FIRST PIECE TO THE LEFT.

The captain commands :

1. *Attention.*
2. *Change front to the left on the first piece.*
3. *March.*

At the second word of command, the officer of the first section orders.

No. 1, *left wheel ; No.* 2, *left about wheel.*

The officers of the other sections order :

By pieces, left about wheel.

The officer of the train orders :

By caissons, left about wheel.

At the word *march*, repeated by the officers of sections, and the train, the pieces and caissons execute the movement required ; the wheel completed, the officer of the train orders :

Forward—guide—left.

The officer of the first section, orders :

No. 2, *left oblique—march.*

The other section officers, order :

By pieces—left oblique—march.

The second piece moves obliquely towards its marker. Having passed him 45 paces, the piece wheels to the left about, and moves into line ; the driver of the wheel horses dressing on the marker, to the right.

The other sections execute the same movement.

When the line of caissons has passed the left flank of the new line about 80 paces, the officer of the train commands :

By caissons—left wheel—march.

The head of the column having moved 60 paces, to the rear of the new line ; the officer of the train orders :

Head of column—left wheel—march.

The caissons being in rear of their respective pieces, he orders :

Caissons, left wheel.

Halt—right dress.

Changing front to the right on the 6th piece, is executed in the

same manner, the sixth piece waiting until the others have wheeled to the left about, before it wheels to the right.*

FOURTEENTH MANŒUVRE.

TO EXECUTE THE CHANGES OF FRONT TO THE RIGHT OR LEFT, BEING IN BATTERY.

Change front on the first piece, to fire to the left, the captain orders:

1. *Attention.*
2. *Change front on No.* 1, *to fire to the left.*
3. *March.*

At the second word of command, the officer of the first section orders:

No. 1, *left wheel—No.* 2, *left oblique.*

The other officers of sections, order:

By pieces—left oblique.

The officer of the train, orders:

Caissons in retreat;

At the word march, he commands:

By caissons—left wheel—march.

Head of Column—left wheel—march.

By Caissons—left wheel—march.

Halt—left dress.

FIFTEENTH MANŒUVRE.

ON FIRES.

1st—FLANK FIRE.

Being in battery, to execute this fire to the right, the captain commands:

1. *Attention.*
2. *Lengthen prolonges for flank firing.*
3. *Flank fire to the right.*
4. *Commence fire.*

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* Changing front on a central piece, is performed by a combined movement of the two preceding cases, as a part of the line moves to the front, the other to

At the second command, the prolonges are lengthened, according to regulation.

At the third, the officer at the third section, orders :

No. 5—in retreat.

The officers of the other sections order :

Section—in retreat.

The officer of the train, orders :

Caissons—in retreat.

He orders the sixth caisson to remain in its position.

At the fourth command, the officers of sections order :

March.

The pieces and caissons (directed) move in retreat.

The non-commissioned officer commanding the sixth piece, directs the limber to rein back; the gunners turn the trail to the left, and move the piece forward, until the extremity of the trail handspikes range with the ammunition chest. So soon as this piece is unmasked, it commences *the fire.* The fifth piece moves in retreat until the chace is abreast the leading horses of the sixth ; it is placed in battery, in the same manner, and commences its fire.

The other pieces move up in the same manner, and commence the fire.

The caissons take their position in rear of their pieces, at their proper distance in battery.

Observation.—A flank fire may be executed, by any portion of the battery, to the right, left, and front, at the same time. Example : the right section should fire to the right ; the centre, to the front ; and the left, to the left. The centre section retains its position ; the wings will execute the movement, and commence the fire as described above.

The fire having ceased, by signal, (of drum or trumpet), the captain commands :

1. *Attention.*
2. *On — piece—dress.*

On which the pieces dress upon the one designated—the caissons likewise dress.

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the rear. It is evident, that the changes of front in battery approaches so very near to the changes of front, that is deemed merely necessary to give the words of command, without entering into any of the details of execution.

2d.—FIRE IN RETREAT, BY ALTERNATE HALF BATTERIES.

To execute the fire in retreat, by half battery, the captain commands:

1. *Attention.*
2. *Fire in retreat, by half battery.*
3. — *Half battery, commence fire.*

At the third word of command, the officer of the half battery designated, orders:

Half battery—halt—commence fire!

The caissons of this half battery halt, by order of the officer of the train.

The other half battery continues to move on, until it arrives on the line of the caissons of the first, and prepares to fire, as soon as it is unmasked.

The half battery which commenced the fire, seeing the other in position, retires to the line of caissons of that one, and directs the guide on that side; the movement is thus continued until the signal to cease fire is given, when the line is formed.

The officer of the train marches with the caissons that retire.

Firing by half batteries, advancing is performed upon the same principle.

3d.—FIRE TO THE REAR.

Being in battery, and it becoming necessary to take this position, the captain commands:

1. *Attention.*
2. *Prepare to fire to the rear.*
3. *Commence the fire.*

At the second order, the chiefs of sections commands:

Pieces—left about wheel.

The officer of the train commands:

Caissons, left about wheel.

At the third word of command, officers of the sections and the train order:

March!

As soon as the caissons have wheeled, the officer orders:

Caissons—forward—trot—march!

The line of caissons, crosses that of the pieces, and assumes its position in battery. The pieces commence the fire as soon as the caissons pass them.

N. B. Firing to the rear, inverting the natural order; to resume it, the captain orders: *by pieces, and caissons, left about wheel—march!, caissons, forward—trot—march!* the officer of the train repeats the four last words of command; at the last, the caissons cross the line of pieces, and resume their first positions in battery.

RETURN TO THE PARK.

The manœuvres being finished; to return to the park:

The captain commands:

1. *Attention.*
2. *Unfix, and coil the prolonges, and limber the pieces.*

He then orders to break into column by pieces, in this manner:

1. *Attention.*
2. *Break off sections.*
3. *March!*

At the second word of command, the officer of the first section orders:

1st piece, forward; 2d piece, to the right oblique.

(In the horse artillery,) the captain adds: *head of column, on trot;* after saying "*break off sections!*" At this second word of command, the officer who commands the second section, orders: *first piece, forward—trot—march; second piece, oblique to the right.*

At the third word of command, repeated by the officer of the first section, in both artilleries, the second piece obliques to the right, to enter the column; the caisson follows immediately its piece.

The second section being on the ground where the first has broken off, its officer breaks it in the same manner, by the same words of command; the same is observed with the third section.

In the foot artillery, the head of the column lengthens the gait.

(In the horse artillery, when the sections are broken off, the captain commands: *walk!*—all the column walks.) The guide who is at the head of the left file, resumes his place in rear of the column.

1st. If the battery arrive in rear of the line, he orders :

1. *Attention.*
2. *Park to the front in line.*
3. *March.*

The pieces and caissons form in line, closing to the distance which is directed.

2d. If the battery arrives by one of its flanks, the captain commands :

1. *Attention.*
2. *Park to the left* (*or right,*) on the left, (or on the right) in line.
3. *March.*

He will take care to direct the head of the column so far to the rear of the intended line of formation, as to have on his flank, the space necessary for the two lines of pieces, and caissons.

END OF THE SCHOOL OF THE BATTERY.

OF THE EVOLUTIONS OF FIELD BATTERIES.

GENERAL RULES.

The preceding school containing the principles and explanation of all the movements which a single battery can perform, we will now apply these principles to a line of several batteries.

For a basis, we will take a line of four batteries, as the rules here laid down will suffice for any number.

Each battery will be designated by a number, according to its rank in line ; the numbers commencing on the right, and terminating on the left.

Two batteries will constitute a division, to be commanded by a field officer.

The divisions must be also numbered from right to left.

The pieces and sections of each battery preserve their numbers. In orders, the number of the battery to which they are attached, will likewise be designated.

REGULATIONS FOR THE WORDS OF COMMAND.

The commander in chief gives the general words of command.

The commanders of division repeat them.

The word "*attention*" will also be repeated by the commandants of batteries ; they immediately after, repeat the general orders relative to their batteries, and without being regulated by each other, they perform the preparatory movement, which precedes the execution of the general one.

The commander in chief gives the orders, which determines the execution of the general movement ; these orders are repeated by the commandants of division, and are executed separately by each battery.

Whenever the line is broken into several columns, the senior officer of each commands it, and performs all the duties of commander in chief.

In case the commanding officer of a battery should not have

distinctly heard the word of command, he will execute the movement of the battery nearest to him.

POSITION OF THE OFFICERS IN LINE, IN COLUMN, AND IN BATTERY.

In line or in battery, the station of the commander in chief is not fixed; he moves where his presence is most necessary.

He is constantly at the head of the column, to direct it.

In the evolutions, he takes a position from which he can best see, and direct the execution of them.

The commanders of divisions are stationed in line in front of the centre of their divisions, three paces beyond the line of captains.

Iu battery they are also in the centre, but on the line of captains.

In column, they are on the directing flank, abreast the centre of the division, twelve paces without the line of guides.

The commanders of divisions will strictly superintend the correct execution of all movements, whether in line, or in column; they may, therefore, repair wherever they think their presence necessary in their division.

The adjutant constantly attends the commander in chief in all the movements.

A subaltern, or sergeant, will attend the commander of division.

In all formations, whether in line or column, their duty will be to post the guides of the division, and he will therefore comply with the regulation on this subject in the school of the battery. The adjutant is charged with the general direction.

The station of the other officers has been already established in the preceding school.

FORMATION OF BATTERIES IN LINE AND IN COLUMN.

The interval between each battery, when in line or in battery, is 54 paces, (36 yards.)

In column of sections the distance is 27 paces, (18 yards.)

In column of subdivisions the distance is 22 paces between each subdivision of pieces or caissons.

The officers commanding batteries are six paces advanced from the commandants of pieces, and the officers of sections in a line with the latter. The officers of the train eight paces advance of the caissons.

REVIEWS OF PARADES.

In parade, the commander in chief is stationed in the centre, on the line of commandants of division. This station has been already prescribed.

The adjutant in rear of the commandant in chief on the line of officers commanding batteries.

The subaltern or non-commissioned officer attending the commandants of division, on the same line in their rear.

MARCHING PAST, OR DEFILING,

Will be as much as possible by column of sections or battery.

The commander in chief is at the head of the column.

The commander of the first division by the side of the commander in chief, opposite to the side on which the person to be saluted is.

The other commanders of division will march abreast of the chief of their first battery on the pivot flank.

The adjutant major on the right of the chief of the first battery.

The under adjutants, abreast with the head of their division on the side opposed to the guide.

The other officers will occupy the place which has been fixed for them, in the school of battery.

FIRST EVOLUTION.

THE BATTERIES MARCHING IN COLUMN OF SECTIONS, THE RIGHT IN FRONT—FORM TO THE FRONT IN LINE (OR IN BATTERY.)

The commander in chief orders :

1. *Attention.*
2. *Form line to the front,* (*or in battery.*)
3. *March.**

The officer commanding the first battery having repeatsd these orders, will execute them in the manner prescribed in the school of the battery.

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* It has been noticed that the commanders of divisions repeat all the orders of the commander in chief ; it is, therefore, to be understood, and no farther mention will be made of it.

At the word, *march*, the officers commanding the second, third, and fourth batteries will order:

Head of column—left wheel.

Each battery, thus forming a *partial* column, directs its march diagonally to about 200 paces in rear of the point which its right is to occupy on the line, where arriving, its officer commands:

Head of column—right wheel.

As each arrives in rear of its point of formation, it forms line, or in battery, as the first has done.

SECOND AND THIRD EVOLUTION.

THE BATTERIES BEING HALTED AND IN COLUMN OF SECTIONS, THE RIGHT IN FRONT, FORM LINE, OR IN BATTERY.

To the left (or on the right,) in line, (or in battery.)

The words of command given in the school of the battery, &c. will be given by the commander in chief, and repeated by the commanders of batteries.

The movement in each battery will be performed precisely in the same manner.

FOURTH EVOLUTION.

TO FORM LINE, (OR IN BATTERY) TO THE FRONT,
(on the first section of the second battery.)

The commander in chief orders:

1. *Attention.*
2. *On the first section of the second battery form line (or in battery) to the front.*
3. *March.*

At the second word of command, the captain of the first battery orders:

By pieces and caissons—right wheel.

The captain of the second battery gives the orders, as directed in the school of the battery, to form to the front, &c.

At the word, *march*, repeated by the captains of the first and second batteries, the captains of the third and fourth batteries order, and cause to be executed, what is prescribed for them in the first evolution.

The second battery forms to the front.

When the first battery has moved 25 paces, the captain orders:

By pieces and caissons, right wheel—march.

And forms his battery in retreat, in line ; dressing on the second ; but he moves 20 paces to the rear, if he be to form in order of battle.

In this case he orders :

By pieces and caissons—left about wheel—march—left dress.

This battery moves up on the line and dresses on the second.

FIFTH EVOLUTION.

THE COLUMN ARRIVING BEHIND THE LINE, AND PBOLONGING ITSELF UPON IT ; AND, IT BEING NECESSARY TO FORM THE LINE TO THE FRONT, BEFORE THE WHOLE ARRIVES IN THE NEW DIRECTION.

Having halted the column, when the two first batteries have entered the new direction, the commander in chief orders :

1. *Attention,*
2. *To the left wheel, and form line,* (*or in battery.*)
3. *March.*

At the second word of command, the captains of the first and second batteries, order :

Left wheel into line, (*or in battery*)

The captain of the third battery orders :

Form line to the front, (*or in battery*)—*guide right.*

At the word, *march*, repeated by the captains of the three first batteries ; the captain of the fourth, orders :

Head of column—left wheel.

The movements are executed as mentioned in the first and second evolutions.

SIXTH EVOLUTION.

THE COLUMN MARCHING IN SECTIONS, THE RIGHT FRONT, FORM COLUMN OF BATTERIES.

The commander in chief orders :

1. *Attention.*
2. *Form batteries.*
3. *March !*

At the word *march*, the captain of the first, forms his battery to the front, according to the rules given in the school of the battery. The caissons close up to 22 paces from the line of pieces.

The other batteries continue to move in column of sections, lengthening the step in the foot artillery, and moving at a trot in the horse artillery.

When the head of the section of the second battery has gained its distance from the first, it resumes the walk, and forms battery to the front, by orders from its captain.

The third and fourth batteries are formed in the same manner.

In the foot artillery, the leading battery will shorten the step until all the others are formed, and at their proper distance, which will be intimated to the captain leading the column, by the commander in chief.

If the left was in front, the movement would be analogous.

Observation.—As it would be more convenient for the foot artillery to form the column of battery at the halt, the commander in chief will send intelligence to the captain of the first battery, who, having formed it, will halt and dress by the left.

The other batteries will form and halt at their distance respectively.

SEVENTH EVOLUTION.

THE COLUMN OF BATTERY BEING HALTED, ITS RIGHT IN FRONT, TO DISPLAY IT ON A NAMED BATTERY.

(Suppose the second ;) the commander in chief orders :

1. *Attention.*
2. *On the 2d battery—display column.*
3. *March.*

At the 2d order, the captain of the first battery commands :

By pieces and caissons—right wheel.

The captain of the 2d battery orders :

Battery forward—guide right.

The captains of the 3d and 4th batteries order :

By pieces and caissons—left wheel.

On the word march being repeated by the captains, the movements are executed, and the batteries gain ground to the flanks.

The right of the first battery having arrived abreast the point it is to occupy in the line, the captain orders :

By pieces and caissons—left wheel—march !

Then :

" *Forward—guide left.*"

The right of the 3d and 4th batteries arriving abreast the point they are to occupy, their captains order :

By piece and by caisson—right wheel—march !

Then :

Forward—guide right.

All these batteries come successively on the line, upon which the 2d is already fixed, and dresses on it.

In this deployment, the new line must be marked out at least 20 paces in advance of the first battery.

EIGHTH EVOLUTION.

THE COLUMN MARCHING, THE RIGHT IN FRONT, FORM LINE ON EITHER FLANK.

To form on the left flank, the commander in chief orders :

1. *Attention.*
2. *On the left battery—left wheel into line.*
3. *March !*

At the second order, the captains of the 1st, 2d, and 3d batteries direct them to move on.

The officers of the train of these batteries, order :

Caissons—forward—trot—march !

At the second word of command, the caissons close on the lines of pieces.

The captain of the fourth battery *halts* it ; and as soon as he perceives the third battery has left him sufficient space to wheel, he orders :

"*Battery, left into line—march—halt—left dress,*"

As prescribed in the school of the battery.

The third battery having left in its rear sufficient space for the fourth battery to form on, beside the interval of 54 paces, the prescribed distance between the batteries, it forms in line in the same manner as the fourth. The others pursue the same course.

NINTH EVOLUTION.

1st CASE.—TO BREAK INTO COLUMN OF SECTIONS FROM LINE, (OR IN BATTERY,)

From one of the wings, (as in the school of the battery.)

2d CASE.—FROM ONE OF THE WINGS OF EACH DIVISION TO ADVANCE.

The commander in chief orders :

1. *Attention.*
2. *On the first section of each division—advance in columns.*
3. *March !*

At the second word of command, the captains of the 1st and 3d batteries order :

" *On the first section—advance in column.*"

The captains of the 2d and 4th batteries, order :

Sections—right wheel into column.

All repeat the order, " *March ;*" and 2d and 4th batteries place themselves in column in rear of one and three.

If you retreat on the left section of each division, each battery will act separately, and the first and third will form column in rear of the second and fourth.

TENTH EVOLUTION.

FROM LINE OR IN BATTERY, FORM THE COLUMN ON A NAMED BATTERY.

(the 2d, for instance.)

The commander in chief orders :

1. *Attention.*
2. *On the second battery, right in front, form column.*
3. *March !*

At the second order, the line of caissons close to 22 paces on the line of pieces.

The captain of the first battery orders :

By pieces and caissons—left wheel.

The captain of the 2d directs his to stand fast.

The captains of the 3d and 4th batteries order :

By pieces and caissons—right wheel.

At the word " *March,*" repeated by the captains of the batteries, they execute the wheel.

Then the captains order :

Forward.

The captain of the first battery places himself on the right of the sixth piece, leads his battery obliquely to the line it is to occupy in column, enters it parallel with the front of the second ; the caissons move on a line parallel with that of the pieces.

The sixth piece of the first battery being nearly abreast the sixth piece of the second, the captain of the first battery commands :

By pieces and caissons—right wheel—march—halt—left dress.

The captain of the third battery, on the left of the first piece, conducts it to the rear, and enters the column in the manner prescribed for the first battery.

The captain halts where his sixth piece is to be placed in column, and when arrived, orders :

*By pieces and caissons—left wheel—march—halt—left dress.**

The fourth battery moves in the same manner on the third.

The column is formed on any other battery in the same manner.

Being in battery, the commander would order the pieces to wheel to the left-about, previous to the execution of either of the above manœuvres.

ELEVENTH EVOLUTION.

TO MARCH IN LINE, PASSING DEFILES—THE FIRINGS.

To march in line, the commander in chief designates a battery of alignment ; he then orders : "*Batteries, forward;*" (*named battery,*) "*battery of alignment—march.*" The other batteries regulate themselves upon the one designated.

Passing Defiles, is executed in the same manner as in the school of the battery.

The Flank Firings, are likewise executed as in the school of the battery ; the orders given by the commander in chief.

Firing in Retreat, by battery, by half battery, by division, is also performed as in the school of the battery.

Firing to the Rear, by the whole line, or only a part, as in the same school.

Firing by Batteries advancing—also the same.

TWELFTH EVOLUTION.

CHANGING FRONT IN LINE AND IN BATTERY.

All the changes of front may be considered as combined in a central movement, as follows :

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* The pieces should move in rear of the line so as to dress on the guide placed on the pivot flank.

To change front on a central battery, (on the right of the third, for example,) to the right.

After having established the first section of this battery on the new direction, the commander in chief orders:

1. *Attention.*
2. *Change front to the right, on the 1st section of the 3d battery.*
3. *March.*

At the 2d order, the captain of the 3d battery commands:

On No. 1. change front to the right.

The captain of the 2d battery orders:

By pieces and caissons—left about wheel.

The captain of the 4th battery, commands:

On the first section, advance in column.

The captain of the 1st battery orders:

On the 3d section, retreat in column.

At the word, *march*, repeated by the captains, each battery performs the movement directed.

The 3d battery forms on the new line, as prescribed in the school of the battery, "to change front on one of the wings."

As soon as the 2d moves, its captain commands:

Right wheel, and then left about.

TO COME UPON THE NEW LINE.

The 4th battery, having broken into column, advances. When the 1st piece is abreast of the point it is to occupy on the new line, it changes direction to the right, and moves up into line.

The 1st battery breaks into column of retreat, and so directs its march, as to arrive perpendicularly on the new line, where its 6th piece is to rest.

The captain of the first battery (when the head of the column arrives on the line,) orders:

Form line in retreat—march!

By pieces and caissons, left about wheel—march!

Halt—left dress.

NOTE.—If the line was in battery, the movement would be analogous.

END OF THE SCHOOL OF THE BATTERY.

SCHOOL OF MOUNTAIN PIECES.

OF THE PORTABLE THREE POUNDER.

Nine men are generally allowed for this, as for the ordinary field piece; but seven may be sufficient.

As to the arms and implements, a pointing handspike suffices; but two other handspikes are necessary to be able to transport the piece by the force of arms, in case of need, and another for the transport of the carriage; in all 4 handspikes,* besides 2 collars, (*called block slings*,) of leather or rope, to hang the piece to the handspikes. This carriage having no limber, needs not the prolonge.

Ammunitions are put in boxes, (a horse carries 2 of them,) a horse or mule carries the piece, a second the carriage, a third one the wheels.

When they are thus in the route, and want to fire, the word of command is:

Prepare piece—for action!

The first matross, (or No. 1,) and the gunner of the right, raise the carriage above the horse, and place it on the ground, in a convenient place.

The matross, (No. 2,) and the gunner of the left, assisted by the 3d matrosses, (Nos. 7 and 8,) lift up the piece, and carry it on the carriage.

The second matrosses, (Nos. 3 and 4,) take the wheels away, and fit them to the carriage; this is done thus: the matross (No. 2) puts his handspike in the bore of the piece, the matross (No. 1) joins him, and they both raise the head of the carriage.

The artificer prepares ammunition boxes; the 3d matrosses (Nos. 7 and 8) join him, and every one takes his post.

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* This piece is not heavy enough to require a folding handspike to be carried. It would be a useless trouble and encumbrance; two slings with a loop, or iron ring, to pass a handspike into, and hang the piece, which is surrounded at the chace by one of the slings, and at the knob of the cascable by the other.

A block sling is a sort of great ring of rope, or leather, about 3 feet long, when open at full length.

At the command :

To action!

the piece is loaded, as those of the *field.*

TO TRANSPORT THE PIECE BY FORCE OF ARMS.

When it is thought proper to carry the piece by force of arms, to pass a muddy ground, or otherwise, the word of command is :

Sling the piece!

The gunner of the left takes two block slings, gives one of them to the matross No. 2, and both sling the piece, (the matross at the chace, the gunner at the knob of the cascable) Then the matross No. 1, and the gunner of the right, supporting each of them a block sling, present the ring or loop to the matross No. 2, and to the gunner of the left, who pass their handspikes into it, and they all face to the front.

Raise—gun!

They raise the piece so as to be able to disengage it from the trunnion plates, and pass it in front of the carriage ; they afterwards lower it at arms length.

March!

They all march together, and step with the left foot ; the second matrosses, (Nos. 3 and 4,) conduct the carriage by pushing to the wheels, or by pulling the bricole fixed to the head of the carriage ; and the chief of the piece comes to the pointing handspike to assist the third matrosses ; Nos. 7 and 8 hasten to assist the second, (Nos. 3 and 4,) if necessary, at the command of the chief of the piece.

If the carriage must be transported ; a handspike is passed through the trunnion plates, to which they fix the cap squares ; another handspike is placed across the trails ; finally, the wheels are taken off, if necessary.

TO REPLACE THE PIECE ON ITS CARRIAGE,

The word of command is :

Halt!

The piece to carriage.

Those who carry the piece, come and take their place at the left side of the carriage. Then at the command :

Raise gun,

They raise it ; and place it on the trunnion plates.

TO FIX THE PIECE ON THE HORSE OR MULE'S BACK,

The command is :

Piece to horse.

This movement is executed by reversing the first mentioned above. That is :

To prepare piece for action.

Observation.—As it may happen that the piece must be carried forward, by force of arms, in the narrow roads of mountains, where the carriage can not turn, or where a horse can not pass abreast, to be fixed to the hooks of the carriage head, in order to go forward ; it is necessary to be provided with bricoles for the Nos. 1, 2, 3, and 4, who may, by that means, draw the piece forward. These bricoles will occasionally be used as slings to transport the piece and the carriage also.

THE DIFFERENT IMPLEMENTS OF THE SLED CARRIAGE EXPLAINED.

OF THE FOLDING HANDSPIKE.

This handspike is composed of two pieces of wood, cut slanting, which are closely joined together by means of two iron boxes, and an assembling bolt held by a small chain ; this bolt passes through the two slanting parts of these pieces, and prevents them from parting asunder. A hook sometimes answers the same purpose.

This folding handspike serves to transport the piece by force of arms, through difficult passages ; they give it 12 or 13 feet for total length, in order to be able to fix 6 men at each side. Six rings, with as many equal swivel pins, are placed equi-distant on this handspike, in order to pass the carrying handspikes through, whenever they wish to carry the piece, which hangs under the folding handspikes by means of three block slings, the first of which is passed round the breech, the second fixed at the handles, and the third at the chace. I have already observed, that the piece of three, is not heavy enough to require the help of the folding handspike for carrying it ; it would be useless, and consequently burthensome. Two slings (even without blocks) and two common handspikes, are sufficient.

OF THE CARRYING HANDSPIKE. (*levier portereau.*)

It is a common handspike which is generally but 4 feet long. It has a notch to contain the ring of the folding handspike, or simply that of the sling, in which it is passed to carry the piece.

CURVED HANDSPIKE. (*levier courbe.*)

This handspike is $4\frac{1}{2}$ feet in its whole length; a part of which (about $1\frac{1}{2}$ feet) is bent, and is introduced into the bore of the piece, when it travels on its sledge, to prevent it oversetting, direct it in the turnings, &c.

OF THE BLOCK SLING. (*collet à billot.*)

The block sling is a cordage about three-fourths of an inch in diameter, and three feet long; having a loop at one end, and a billet, or block, at the other, entering in the loop, and keeping the cordage doubled when they encircle the piece with the block sling, and hang it under the folding handspike, which passes in all these slings. When they do not choose to have a folding handspike with rings passed in the strings, they must have a ring with a loop to introduce the carrying handspike into it. It is useless to have a billet or block sling, to the neck of the chace, and to that of the button; they may use round plain slings. (It is a useless complication to have block slings of different lengths, according as they embrace the piece, at the chace, the handles, or the breech, in order to keep it in a horizontal position; it suffices to turn twice, that of the handles, round one of them, and to seize the button instead of the breech.) If slings were deemed necessary for the carriage, they must be at least 4 feet.

OF THE POINTING COINS FOR A SLEDGE CARRIAGE.

There are two sorts of pointing coins, for each piece: one with a hook, embraces the front of the supporting transom; its hook is underneath, and there is a groove above: The other coin has a handle, and enters the groove of the first; they are bored through, and tied together by a small rope.

OF THE CHEVRETTE.

The chevrette which serves to raise the head of a sled, or any other carriage, made use of without fore-wheels, (or large trucks,) in firing it, is, as we have already said, a sort of frame, composed of two upright stanchions, a transom, a body of an axle-tree, with trucks, which are steadily fixed to the carriage by means of iron chevrette straps, with hooks, &c.

SCHOOL OF SIX POUNDERS, OR HOWITZER, UPON SLED CARRIAGE.

Eighteen men are wanted; viz.

2 gunners, and 6 matrosses, as for the field pieces; both for the execution and supply.

4 auxiliary matrosses, to assist the others in carrying the piece by force of arms, when necessary.

4 auxiliary matrosses, to carry the carriage.

2 artificers, who, in case of need, assist the gun carriage bearers.

ARMAMENT AND IMPLEMENTS.

As those of the common field pieces; but with the following pieces besides:

The chevrette, and its bolt,* The folding handspike, Three block slings, Ten carrying handspikes,† One curved handspike,‡ Two pointing coins.	Carried by a pack mule, with the other implements, such as buckets, sponges, &c.

The piece being on its sled carriage, the men are placed in double files in rear of, but facing the piece, in the following order:

On the right file: matrosses Nos. 1 and 3—1 gunner; then, 7, 9, 11, 13, 15.

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* The sled may also have high trucks, instead of a chevrette.

† They often put 15 carrying handspikes, and 4 block slings, to have some spare ones. I only mention here what is necessary. In the second volume, mention will be made of the supplies wanted to complete a mountain equipage.

‡ It is often necessary in a march, to contain the carriage.

On the left file: matrosses Nos. 2 and 4—gunner; then, 8, 10, 12, 14, 16.

To manœuvre, they order:

To your posts!

The first and second matrosses, (Nos. 1, 2, 3, and 4,) and gunners of the right and left, march together with quick steps, and by files, to come up with the right and left of the piece. The first matrosses, (Nos. 1 and 2,) halt at the mouth; the seconds, (Nos. 3 and 4,) at the trunnions; the gunners, at the breech of the piece. The other matrosses, and assistants, do not move. The artificers are at the ammunition chests.

Front!

The men on each side, face to the piece.

Prepare supplies and implements, for the piece! (or battery, if there are many pieces.)

The matrosses Nos. 3 and 4, followed by Nos. 9, 10, 11, and 12, go to the mules, loaded with the arms and implements, to take, and carry near the piece those which are wanted, viz. on the left, the chevrette bolt, and 4 handspikes; on the right, the chevrette, bucket, and 2 pointing coins. They prepare, afterwards, the folding handspike, the six carrying handspikes, and three block slings, for the occasion. The matrosses Nos. 3 and 4, take charge of the tube-bag, priming-wire, port-fire case, and resume their posts; the matrosses Nos. 9, 10, 11, and 12, remain near the implements prepared for the piece, in case of need.

The matrosses Nos. 7 and 8, go to the ammunitions to supply the piece. The matrosses, Nos. 13, 14, 15, 16, place themselves aside, and ready to carry the carriage, if necessary. They also assist in supplying the piece, occasionally.

Place—chevrette!

The two gunners put each of them their locking bolt to the trucks; then those on the left lift up two handspikes, and pass one of them to the matross No 2, the other to No. 4.

The matross No. 2, places his handspike in the bore of the piece.

The matross No. 4, passes his crosswise under that which is in the bore, facing the enemy.

The matross No. 1, takes the end of the handspike of No 4,

taking a similar position ; and these three matrosses raise the carriage.

The matross No. 3, takes the chevrette, and, passing before the matross No. 1, places it under the carriage.

The left gunner takes the bolt of the chevrette, and places it.

The matross No. 1, puts the key of this bolt.

All resume their posts. The matrosses Nos. 2 and 4, keep their handspikes, and hold them vertically in their right hand.

TO PASS FROM THE TRAVELLING TRUNNION PLATES TO THAT OF ACTION.

The command is :

"*Change trunnion plate.*"

The matrosses Nos. 3 and 4, take off their respective cap squares.

The matross No. 2, introduces the butt of his handspike in the chace.

The matross No. 4, passes his handspike crosswise under that of No. 2, close to the muzzle of the piece.

The matross No. 1, steps on, to the end of that handspike, and seizes it, facing the enemy, as well as the left matross, No. 4.

The matross No. 3, seizes the handles with his two hands, to prevent the piece from turning.

The left gunner takes a handspike, which he passes under the butt of the cascable.

The right gunner seizes upon the other end of this handspike.

These six men, acting together, support the piece, and carry it in the action trunnion plate.

The matrosses Nos. 1 and 3, put again their respective cap squares.

The left gunner lays his handspike behind him, and keeps in hand those of the matrosses, Nos. 2 and 4, who hand them to him, from hand to hand.

The right gunner places the pointing coins under the breech of the piece.

They all resume their respective posts.

"*To action.*"

The matross No. 1, prepares his sponge, and the matrosses, Nos. 3 and 4, the priming tubes, wire, and port-fire stock.

The matrosses Nos. 7 and 8, bring ammunition to the matross

No. 2; and the latter goes for them, if at the command *action*, he has not received any.

The gunner of the left, passes a handspike to the right matross, (No. 3,) and they both apply their levers to the flasks, to direct the piece.

The gunner of the right steps on in rear of the flasks; guides those who give direction to the piece, and gives the word of command:

"*Load.*"

The gunner of the left stops the vent with his left hand; while, with the right, he applies his handspike under the breech, in order to fix the elevation of the pointing. He resumes his post when the piece is loaded.

The gunner of the right takes aim, and returns to his post when the piece is pointed.

The matross No. 3, applies his handspike under the breech, assists in pointing the piece, withdraws; then lights his port-fire.

The matross No. 1, sponges, and places the charge; the matross No. 2, rams down the charge.

The matross No. 4, when the gunner of the left withdraws, pricks, primes, withdraws, and makes the signal for firing.

The matross No. 3, fires at that signal, and keeps his handspike.

TO CARRY THE PIECE BY FORCE OF ARMS.

The word of command is:

Sling the piece.

The matrosses Nos. 2 and 4, and the matross No. 3, give their handspikes to the gunner of the left, who returns them to their places beside the trucks.

The matrosses Nos. 3 and 4, take off the cap squares. The gunner of the left takes three block slings, gives one to matross No. 2, another to No. 4, and places the third.

The matross No. 1, and the gunner of the right, take, each of them, one half of the folding handspike, and lay it on the piece where they assemble its parts assisted by the matross No. 3, who passes the assembling bolt.

The matrosses Nos. 2 and 4, and the gunner of the left, sling the piece: No. 2, by the chace, No. 4, by the handles, and the gunner by the breech.

The gunner of the right, when the piece is slung, makes the signal for every one to resume his post, and he commands :

Assist.

The matrosses Nos. 7, 8, 9, 10, 11, and 12, rapidly join the the piece. Those of the left take each of them two handspikes, as they pass by, and take their place on the left of the left file ; as soon as they reach it, they hand to every one of the other matrosses, and to the gunner of that file, a handspike. Nos. 7, 9, and 11, walk to their place on the right of the right file. At the word of command, "*sling the piece*," the matrosses Nos. 9, 10, 11, and 12, must have brought the folding handspike to the right side of the piece, the carrying handspikes and the block slings at the left.

With the left hand, the matrosses and the gunner of the right present the rings of the folding handspike to the left matrosses, and to the gunner of the left, who pass their handspikes into it, and all face the front, towards which the piece is pointed.

Raise—gun.

They all together raise the piece, so as to be able to disengage it from the trunnion plates, and pass it in front of the carriage.

Lower—gun.

All lower the piece the length of their arms.

March.

All, at once, step with the left foot. The four assistants purported to transport the carriage, step to it immediately ; they take off the chevrette, place it on the sled carriage, with the rest of the arms and implements ; or else, they load them upon a pack mule, if they are considered as too heavy, on account of the difficulty of transportation. They, afterwards, place the cap squares, and keys, pass a handspike in the trunnion plates, another in the large rings of the harness chain, and, loaded with the carriage, they follow the piece.

The artificers, if necessary, give them their assistance : they pass a handspike across the flanks, and, in that situation, help to transport the carriage.

If the road happens to be narrow, the word of command, for the matrosses who carry the piece will be :

By file—to the right and left—pass the defile.

At this command, the right file will close against the piece and gain the front of it ; and, in the same manner, the left file will come close to the piece, and take its rear.

If the road opens wider, the word of command will be : *forward!* and every one will resume his former position, by an inverse movement.

When it is thought proper to replace the piece on the carriage, the word of command is, (if it is to fire :)

Prepare piece—for action.

The carriers of the piece make, *right about*, turning round the end of the handspike, and resume the step

Those who carry the carriage lay it on the ground ; place again the chevrette ; open the cap squares ; place their handspikes on the left, in front of the trucks ; and march to their post in the rear.

The carriers of the piece bring it near the carriage, and at the command: *raise gun*, they raise it, and replace it in the action trunnion plates.

At the word of command:

Unsling the piece,

The matrosses and gunners of the left pull off their handspikes ; the matrosses, (Nos. 8, 10, and 12,) on that side, seize, each of them, two handspikes.

The matrosses Nos. 2, and 4, and the gunner of the left, unsling the piece.

The second matrosses, (Nos. 3 and 4,) place the cap squares.

The gunner of the right places the pointing coins.

The folding handspike is delivered to the matrosses Nos. 9 and 11, and the block slings to Nos. 10 and 12, who return them to their place—they all resume their posts.

If the intention were, when the piece has been placed on the carriage, to travel instead of firing, the word of command would be :

The piece in travelling trunnion plates!

Those who carry the carriage, lay it on the ground, unkey the cap squares, take off the chevrette, arms and implements, see that they are loaded upon the mules ; and resume their place, in rear of the carriage.

Those who carry the piece, bring it near, and proceed as above, except that they place the gun in the travelling trunnion plates, and that the gunner of the right does not replace the coins.

The howitzer of 24, upon the sled carriage, may be fired without chevrette, and under a very great angle, by withdrawing the moveable pointing plate.

The service of the mountain 8 inch mortar, would be executed conformably to what has been said just before.

The 12 pounder, not being transportable by force of arms, does not require in mountains more men for its service than the field piece intended for an open campaign. It travels upon a sledge, and is placed upon a carriage whose head is mounted upon high trucks, while the trails are fixed upon the fore part of the sledge; the piece is afterwards brought in the action trunnion plates. This is a simple mechanical manœuvre.

END OF THE SCHOOL OF MOUNTAIN PIECES.

ON THE EXERCISE

AND MANAGEMENT OF

SIEGE, GARRISON, AND SEA COAST GUNS.

SIEGE PIECE OF THE CALIBER OF 24, 18, OR 16.

To serve a 24, an 18, or a 16 pounder, mounted on a travelling carriage, eight men are necessary,* viz.

Two gunners.
Two 1st matrosses, (Nos. 1 and 2.)
Two 2d do. (Nos. 3 and 4.)
Two 3d† do. (Nos. 5 and 6.)

These men are drawn up in file, on the right and left of the gun; Nos. 1 and 2, one pace from the hurter; 3 and 4, one pace from them; 5 and 6, one pace in their rear; and the gunners, one pace from them.

THE ARMAMENT AND EQUIPMENT FOR THE PIECE, IS AS FOLLOWS:

On the left,

3 *Manœuvring handspikes*, } Placed on the platform parallel to the piece, the small ends towards the epaulment; the end of each, on a line with the middle of the other; that of Nos. 1 and 2, nearest the gun, and so on.

1 *Wedge*, } rests against the hurter, at the extremity of the hurter.

1 *Sponge*, 1 *Rammer*, } Placed on a rack to the left, the rammer below.

— *Shot*, near the epaulment.

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* This service may be performed by five men, as with the howitz, being assisted by the gunners of the neighbouring piece, to run in the gun from battery; this aid is required only for the first time, as the gun afterwards runs back by the recoil, and five will suffice to run her out.

† I have differed from the established method of West Point School in numbering the matrosses in the field artillery. However, had I not feared to be in opposition to usage, and to show a fancy for alterations, (which in themselves are of no importance,) I would have, for the advantage of uniformity, adopted the Nos. 5 and 6 for the 3d matrosses, as established in the present manœuvres, in preference to the matrosses 7 and 8, adopted for the field artillery.

1 *Linstock*, } in the rear, 10 paces from the rack, and in rear of the left.

1 *Thumbstall*,
1 *Pricker*,
1 *Priming horn*, *or* } In charge and carried by the gunner of the left.
1 *Tube Box*,

ON THE RIGHT OF THE PIECE.

3 *Manœuvring handspikes*, } placed as those on the left.

1 *Wedge*, do. do.

— *Wads*, near the epaulment.

1 *Apron*, covering the touch-hole.

1 *Broom*, against the epaulment.

1 *Box for Cartridges*, } In the prolongation of the file of the right, a little without the line of gunners, and 22 paces from the racks.

WORDS OF COMMAND.

Suppose the detachment, in double file, arrives by the flank in rear of the piece, the duties of each being prescribed; the chief of the gun orders:

To your posts—march!

Nos. 1 and 2, followed by the others according to their stations, observing a distance of one pace between them, file to the left of the rear, and halt without orders when the Nos. 1 and 2, arrive within one pace of the hurter.

Front!

The gunners and matrosses front the piece.

Prepare for battery, or service.

The gunner on the right takes off the apron, and places it against the epaulment; the gunner on the left furnishes himself with the priming horn, the pricker, and the thumbstall; the matrosses arrange the handspikes, and other implements, as before described. All being arranged, the following orders are given for exercise.

To handspikes!

The men seize the handspikes with life; those on the right with the left hand, the others with the right.

Unbar!

Nos. 1 and 2, the back to the epaulment, unbar under the tire

of the wheels; 3 and 4, between the spokes, the handspikes supported against the felly; 5 and 6, at the flasks, near the trail; the gunners assist Nos. 3 and 4.

Run back!

The gunners and matrosses act together, and push back the piece as far as it is necessary to load it; the men (Nos. 5 and 6,) at the trail, must be careful to keep it in the middle of the platform, that the muzzle of the gun, in leaving the embrazure, does not injure the cheeks.

Level the piece, and chock the wheels!

Nos. 1 and 2 chock the wheels with the wedges, and resume their position before the recoil of the piece; Nos. 3 and 4 unbar under the first reinforce; Nos. 5 and 6, remain in their former position; the gunner on the left, resumes his post; the gunner on the right, steps up smartly between the flasks, the left leg advanced, he places the piece horizontally for loading; for this purpose, he directs the men at the handspikes what they are to do; he gives them a signal, on which he, with them, resume their positions.

At the word,

Ground—handspikes!

The matrosses stoop down, lay their handspikes on the platform, without noise, and resume their positions.

Stop vent—sponge—cartridge!

No. 2 seizes the sponge, enters it into the muzzle, and with the aid of No. 1, rams it home; the gunner left stopping the vent with his right thumb; No. 3 is on a line with exterior racks. On a signal made by the one at the gun on his left, (when the battery consists of several pieces, whose duty it is to supply it with powder,) he repairs to the cartridge box, seizes it with his right hand, and faces the battery, (when there is no purveyor to the battery, No. 3 goes to the small magazine, to supply his box, or to the portable caisson in the rear of the battery, to supply himself.)

Sponge!

Nos. 1 and 2, holding the sponge in both hands, (locked,) the fingers of the right hands above, and those of the left hands below the staff; they turn the sponge 5 or 6 times in the bottom of the bore, draw it out, and place it against the embrazure; No. 3 advances to the battery, hands a cartridge to No. 1, and immediately after a wad; he then returns to his position in the rear, and places the cartridge box behind him.

Replace sponge—take rammer!

No. 2, replaces the sponge, seizes the rammer, and holds it horizontally in the embrazure.

Load—cartridge!

No. 1, puts the cartridge into the gun, and a wad upon it, seizes the rammer, and assists No. 2 to ram home the charge.

Ram—home!

After ramming home, and striking four equal strokes upon the charge; Nos. 1 and 2, draw out the rammer, and place it in the embrazure; No. 4, seizes a shot, No. 3, a wad.

Shot, the gun!

No. 2, receives from 4, the shot, places it in the gun; No. 1, does the same with the wad he has received from No. 3, and seizes the rammer, which they enter into the piece.

Ram—home!

They ram home the shot and wad with two equal strokes, draw the rammer, place it in the embrazure; No. 3 and 4, resume their posts.

Replace—rammer!

The gunner on the left resumes his post; No. 2, replaces the rammer on the rack; No. 1, takes the broom, sweeps the platform; they resume their posts.

To handspikes!

To be executed, as before explained. At the same time, Nos. 1 and 2, take out the wedges, and replace them.

Embar!

Facing the epaulment, Nos. 1 and 2, embar between the spokes, their handspikes against the fellies; the 3 and 4, under the wheels; 5 and 6, under the trail; the gunner on the right, in rear of the piece, opposite the embrazure.

In battery!

The men act together, to run out the gun; the gunner on the right is attentive to the chace of the piece entering the centre of the embrazure.

Point and direct the piece!

Nos. 1 and 2, embar, and resume their posts; Nos. 3, 4, 5, and 6, face inwards, turning round their handspikes; Nos. 5 and 6, embar under the trail; Nos. 1 and 2, under the first reinforce; the gunner on the right, between the flanks, points and directs the piece, and at a signal, he, with the men, resume their posts.

Ground handspikes!

The men replace their handspikes without noise, and rise together.

Prick and prime!

The gunner on the left moves to the breech of the gun, pricks with the right, and primes with the left hand; having filled the touch-hole, he lays a train in the gutter of the vent, at the extremity he bruises the grains with the horn, and resumes his post; (if the gun is not primed with powder, a tube is used;) No. 3, seizes the cartridge-box with the right hand.

To linstock—to the wedge!

Nos. 1 and 2, face the epaulment, the gunners, and others, face outwards, and place themselves in file, at the extremity of the platform, one pace from each other.

March!

The gunners Nos. 3, 4, 5, and 6, leave the battery; No. 4, halts at the linstock, seizes it with the right hand, and places it in the hollow of the left arm; the others move on; the gunners arriving on the alignment, they face inwards, and march forward, and halt without orders, when at the distance of two feet from each other; the matrosses take their position successively, as they arrive on the alignment of the gunners.

Front!

The gunners Nos. 3, 4, 5, and 6, face to the epaulment; No. 3, carries the cartridge box to its position, and immediately resumes his post, in file.

Linstock advance—march!

No. 4, advances to the right, or left, of the piece, according to the wind, (on the right of the piece, he faces from the epaulment, and on the left of the piece he faces the epaulment,) the gunner on the right, repairs to the right, or left of the gun, (according to the wind,) to observe the effect of the shot.

Prepare to fire!

No. 4, takes the linstock over the left arm, (to strike off the ashes,) extends his arm, the nails upwards, four inches above the line of the extremity of the train of powder; Nos. 1 and 2, at the same time, take out the wedges.

Fire.

No. 4, then touches with his match the extremity of the train of powder, withdraws it as soon as the powder has caught, being

careful always to withdraw it on the line of the chace; and retires to his position in file. As soon as the piece is discharged, Nos. 1 and 2, chock the wheels, remain at their posts, facing the epaulment.

A roll of the drum is the signal to cease firing, and for the gunners to return to the alignment; when at that point, the order is given:

Gunners and matrosses to your posts—march!

Nos. 3 and 4, advance to the front; Nos. 5 and 6, and the gunners move in file in their rear; each file approaching the battery, halts as soon as he arrives at his position, and faces at the order "*front.*" Were the exercise to be continued, the preceding words of command would be given.

The following words of command would be given, to place all in order, and to leave the battery:

1. *Gunners, and matrosses, to your posts—march.*
2. *Front.*
3. *To handspikes.*
4. *To run up the gun in battery—embar.*
5. *Run up (or out) the gun.*
6. *Depress—gun.*
7. *Put on—apron—replace handspikes.*
8. *Right and left, outward face.*
9. *March.*
10. *Halt*, (when the gunners arrive near the alignment, 26 paces in the rear.)
11. *Right, or left face*, (according to the flank you are to move from.)
12. *Files close—march.*
13. *Forward—quick—march.*

At the 6th word of command, Nos. 3 and 4, embar under the breech; the gunner who points, enters between the flasks, raises the breech, so as to depress the muzzle; he then gives the signal, and the men resume their stations; No. 1, during the time of depressing the gun, sweeps the platform.

At the 7th word of command, the men place their handspikes against the axletree, within the wheels; the gunner replaces the apron, and all resume their posts.

At the 8th, they face to the right and left.

At the 9th, they leave the battery.

At the 10th, they halt.

At the 11th, they face.

At the 12th, they close to the leading file, which stands fast.

At the 13th word of command, they step off in quick time, to resume their arms, or return to quarters.

TO PERFORM THE EXERCISE, (*à la muette.**)

Order :

Load. { All the movements are gone through without orders, until the following, which is preceded by a roll, for the men to resume their posts.

Linstock—and wedge. { No. 4 faces outward ; the others face the epaulment.

March ! { No. 4 goes for the match, and returns to piece immediately ; the gunner goes to the epaulment to observe the shot ; the rest closes near the epaulment, and Nos. 1 and 2, are ready to wedge the wheels.

After the firing, a roll is the signal for the men to resume their stations at the piece.

Exercising by the drum, each tap indicates a word of command.

THE HOWITZER.

At a siege, five men are necessary to serve a howitzer :

One bombadier (on the left of the howitzer.)

Nos. 1 and 2, (matrosses,) on the right and left.

Nos. 3 and 4, (matrosses,) on the right and left.

Nos. 1 and 2, two paces from the epaulment, Nos. 3 and 4, one pace distant from these, the bombadier one pace distant from No. 4.

The implements and equipments are arranged in the same manner as at the gun, except the shells, which are 25 paces from the epaulment in rear of the linstock ; a basket in rear of No. 1, a quadrant against the epaulment, near No. 2.

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* *A la muette* : that is, without any other words of command, but those indicated toward the margin.

THE IMPLEMENTS AND EQUIPMENTS, ARE:

On the left.	On the right.
2 Handspikes,	*2 Handspikes,*
1 Sponge and rammer,	*A basket, containing* { *A Curette,* / *A bag filled with earth,* / *A spatule,* / *— splints,* / *A pair of sleeves,* }
1 Thumb stall,	*A cartridge box.*
1 Pricker,	*A broom,*
1 Tube box,	*An apron,*
1 Quadrant.	*A tompkin (or stoppon) to close the muzzle.*
1 Linstock,	
— Shells (in rear of linstock.)	

The words of command: *gunners, and matrosses, to your posts—march—front,* is performed (as before described.)

At the order: *take implements,* No. 1, takes out the tompkin; No. 3, takes off the apron; No. 1, puts on his sleeves; the bombadier takes the tube box, a priming wire, and a thumb stall; the others are provided in the same manner as has been prescribed for the battering piece.

Whatever variation there may be in the words of command from those of the gun, will be noticed; they, however, differ but little.

To handspikes—(Same movement as at the gun.)

Embar! { Nos. 1 and 2, embar in the spokes; Nos. 3 and 4, at the flasks; the bombardier opposite the centre of the embrazure, that he may be certain the howitzer is directed to that point.

Retire from battery—(Same movement as at the piece.)

Button—wedge!

Nos. 1 and 2, wedge the wheels, and resume their posts; No. 3, embars under the breech, and raises the breech; the bombardier passes between the flasks, and prepares the howitzer for loading; he gives the signal; No. 3, takes out his handspike, and all resume their posts.

Lay down handspikes—(Same movement as at the gun.)

Clean howitzer!

The bombardier repairs to the breech; stops vent with the right hand; No. 2 places the sponge in the embrazure; No. 1 takes the scraper and sand-bag, cleans the howitzer, replaces them in the basket, after using them; he takes the sponge, introduces it into the chamber, turns it two or three times, draws it out, and places it in the embrazure, with the rammer towards the piece.

Load—with powder!

Nos. 3 and 4 immediately retire to the extremity of the platform, and at a signal by No. 3, at the piece, on the left, they all move off for ammunition; No. 3 for powder; No. 4 for shells; they retire and halt when within 20 paces off, and covering their file leaders.

Load!

Nos. 3 and 4 repair to the battery, and hand the powder and shell to Nos. 1 and 2; they then retire to their posts, No. 3 having placed the cartridge pouch behind him; No. 1 places the charge in the chamber; rams it gently; returns the sponge to No. 4, who places it on the rack.

Load—shell!

No. 2 hands the shell to No. 1, and resumes his post; the shell is placed by No. 1 on the charge, careful that the fuze is outward, and in the direction of the axis of the piece, he then secures it with four splints, which he receives, with the spatula, from No. 3, to whom he returns it after having finished, and it is placed in the basket; No. 1 sweeps the platform, and all return to their posts.

Handle handspikes!
Embar!
To battery! } Performed, as at the gun.

Give degrees—point!

No. 2 unbars, and lays his handspike on the platform; the three others shift theirs; No. 1 enters his under the breech; the bombardier enters between the flasks to direct the piece with the aid of Nos. 3 and 4, who have embarred at the trail; the bombardier gives the degree of elevation, by means of the elevating screw; he is assisted in this duty by No. 2, who has placed the quadrant between the handles, to ascertain the number of degrees. No. 1 raises the breech to assist the motion of the screw. The howitzer pointed, the bombardier gives a signal with both hands, on which No. 2 replaces the quadrant, the three others unbar, and

each resumes his post—(Instead of the quadrant, a moveable sight is used to give the degrees.)

Ground handspikes!

Prick—prime! { The bombardier pricks with the left; primes with the right; and returns to his post.

Linstock and wedges!
March!
Front!
Linstock—march!
Raise arm!
Fire!
Gunners and Matrosses, to your posts—March!
} To be performed in the same manner as at battery guns.

BATTERING GUNS, 12 AND 9 POUNDERS.

Six men are required for these calibers, 2 gunners and 4 matrosses; 4 handspikes are sufficient; the implements and equipments are the same as for the 24 pounder.

POSITION AND DUTIES OF THE SIX MEN.

Nos. 1 and 2 are stationed one pace from the hurter, and perform the same duties, as at the 24 pounder; they, besides, do the duties of Nos. 3 and 4, when these last are doing the duties of Nos. 5 and 6.

Nos. 3 and 4 are at one pace distance from the others; they are occasionally to perform the duties of Nos. 5 and 6 at the 24 pounder.

The gunners, one pace distant from 3 and 4, perform the same duties, as the gunners at the 24 and 18 pounders.

BATTERING 3 POUNDER—USED AT SIEGES.

Five men for this piece, as at the howitzer, (one gunner and four matrosses.) The 6 pounder may even be manœuvred by the same number of men. The 3 pounder may be manœuvred by three men, in case of need.

GENERAL OBSERVATIONS UPON THE EXERCISE OF BATTERING, GARRISON, AND SEA COAST GUNS.

1st. ON THE FORMATION OF THE DETACHMENTS INTENDED FOR THE SERVICE OF EACH PIECE, WHETHER IN SIEGE, GARRISON, OR SEA COAST BATTERIES.

In the schools of artillery, these detachments march to the polygon with arms, unless ordered to the contrary by the commanding officer.

The detachment for each gun is drawn up in the ranks, on the company parade, they march either by files, or by sections; when they arrive at the polygon, they are wheeled into line in front of the gun-racks, and when dressed, the following words of command are given:

Right about face.
Present arms.
Lodge arms.

Directions are given to take off the accoutrements. &c. (we are to suppose the battery composed of several different calibers, mounted behind an epaulment, on field, garrison, and sea coast carriages.)

The detachments for each piece are then assembled in two ranks; the front rank consisting of the men of one side of the piece, the rear rank of those of the other.

The officer commanding the detachment, and who directs the exercise of the piece, is 2 paces in front of the centre.

The detachments break off by the following command:

By detachment—right face—march!

If you are to enter the battery on the left; but to the left, if you enter it on the right; that the right of the detachment may be on the right of the battery

Column—forward.
Guide to the right, or left, according to the flank.
March.

At this last word of command, the officers post themselves two paces beyond their exterior flank of the column, to wit, on the opposite side of the guide.

On entering the battery, the detachment prolongs the line marked out twenty paces from the exterior tressels, leaving that

line within ; to wit, between them, and the pieces ; should there not be sufficient space beyond that line, they would move along that of the linstocks ;* each file halts, as it arrives on a line with the piece, he is to be stationed at ; the commanding officer then orders :

Front.

The files face the epaulment ; the non-commissioned officer between the two files, opposite the piece ; the officer commanding the detachment, faces :

To your posts—march.

Each file moves on to its position at the piece, and halts ; the officers and non-commissioned officers, halt on the line marked out for them.

At the order "*to prepare for battery*," the matrosses arrange all the equipments and implements in the order previously prescribed ; all the arrangements being made for exercise, the roll is beat, and each man takes post ; (in all the movements of exercise, the greatest celerity must be used ; in all cases of individual movement, the person only to be employed, is to move ; the others observe the strictest silence and attention.)

NOTE.

At the school of practice, one particular detachment is designated to provide the battery with its equipments, &c. ; after the exercise, to collect and replace them in store ; otherwise, the men at each piece, under the charge of the non-commissioned officer, perform this duty.

2. ON THE DUTIES OF NON-COMMISSIONED OFFICERS.

At the command "*prepare for battery*," the non-commissioned officers examine whether all the equipments and implements are fixed in the prescribed order.

When the order is given "*to linstock—to wedge*," they face to the right about.

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* The preceding part supposes the detachment halted at the racks, remote from the battery ; and that it enters it by the right, or left ; but if the detachments were in line in rear of the battery, then, instead of breaking off, they would be ordered : *right face, file to the left—march!* and each file would move opposite its piece.

At the word "*march*," they advance direct to the front to the alignment in the rear, and face to the right about; (the battery;) they are then placed in the centre of the two files of the piece.

During the firing, they must be vigilant and careful that no man leaves his post without order, except the gunner who points, who may go either to the right or left of the piece, to observe the effect of the shot.

They will speak in a low voice, to correct the faults of individuals; and if it is necessary to leave their posts to correct a fault, they will return to it as soon as the object is accomplished.

When the exercise is gone through, without either words of command, or the taps for the particulars, the non-commissioned officers are not required to be stationary, or immovable; they may repair to any part of the battery, where their presence may be necessary for their piece.

3. ON THE DUTY OF THE OFFICERS.

Except in case of parade, the officers are not required to be stationary; they may move to any point, where their presence may be requisite.

It is specially their duty to cause the greatest silence and order to be observed.

They must observe that the men stationed at the piece direct their view always to the epaulment, and never on the officer who commands.

That every movement is done with life, order, and precision.

They must be attentive, that the man who attends the vent never moves his hand during the time the men are loading, otherwise serious consequences might result.

That the men do not trail their handspikes on the platform.

That the men who sponge are attentive to turn the sponge several times at the bottom of the bore, and in ramming the charge home, they extend the arm as much as possible.

That they extend the legs as much as possible in ramming the charge, by that means their height is diminished, and less exposed to the enemy's fire.

That the purveyors, in going for ammunition, dress by the right.

At the word of command: *to linstock—march*, the officers will

repair to the right or left of the battery, to observe the effect of that shot; that they may correct any error, in the direction of the piece.

The officer commanding the battery will be careful that each word of command is executed before he gives another, except that of: *load with powder*, which will be given as soon as No. 2 leaves the muzzle, to replace the sponge.

ON THE SEVERAL ALLIGNMENTS TRACED IN THE BATTERY.

Five paces in the rear of the racks, (for spongers and rammers,) an alignment is traced by small pickets, or turf, for the non-commissioned officers, commanding pieces; they take post opposite the centre of the gun.

Two paces and a half from this, another is traced for the officers commanding sections; a sort of turf is used for this purpose, placed opposite the centre of each interval of pieces.

Two and a half paces from this line, is another for the linstocks, the bucket is fixed in a square space of turf opposite the file on the left.

Five paces from this another line is marked out, and a sod is laid down to fix the posts of the commandants of companies, if the battery is an extensive one, and commanded by a field officer.

Five paces in the rear, consequently, 20 from the racks, the line for the gunners is traced, and 2 paces in the rear, covering the file on the right, a turf is placed for the cartouch box, or pouch. About five paces in the rear, opposite the centre of the battery, is the magazine constructed with plank, sunk two feet in the ground, six feet in the clear, from 6 to 8 feet square; the door on the opposite side to the battery. This magazine should be covered on the outside with turf.

GARRISON PIECES OF 24 POUNDERS, 18 POUNDERS, &c.

For the service of one of these guns, on a garrison carriage, five men are required.

1 Gunner, (on the left.)

4 Matrosses, (on the right and left of the piece.)

Four handspikes are sufficient, and, instead of mallets, wedges

are used to choke the gun. The implements and equipments are the same as for battering guns.

The words of command:

Gunners and matrosses, to your posts—March.

Front—prepare Battery.

Are executed, as before stated, for battering guns; except No. 3 takes off, and replaces the apron.

WORDS OF COMMAND.

To Handspikes.

The four matrosses stoop down, and take their handspikes.

Embar.

Nos. 1 and 2 enter the handspikes, under the wheels; Nos. 3 and 4 between the spokes.

From Battery.

They act together, and press back the piece from the parapet, as far as it is necessary to load it without constraint.

To the knob—to wedge.

Nos. 1 and 2 choke the wheels, and resume the position they were in, before running back the gun; Nos. 3 and 4 enter the handspikes under the first reinforce; the gunner steps up on the frame at the breech, and disposes the chace of the gun, so that the charge can be introduced; Nos. 3 and 4 raise the breech to facilitate the working of the pointing screw; he then makes a signal with both hands; Nos. 3 and 4 take out their handspikes, and all resume their posts.

Lay down Handspikes.

The handspikes are placed on the platform, without noise.

To sponge—stop vent—to cartridge

No. 2 seizes the sponge, and enters it into the muzzle of the gun, assisted by No. 1; the gunner stops vent with the right hand; No. 3 places himself on a line with the exterior racks, and at the signal made by No. 3 of the piece on the left, who performs the same duty, he repairs to the cartouch box, seizes it with the right hand, and faces the battery. If the box be empty, he replenishes it at the small magazine, or from the caisson, called rampart caisson.

Sponge.

Nos. 1 and 2, sponge by turning it 7 or 8 times in the bottom of the bore; they withdraw and place it against the parapet; No. 3

advances to the battery, and hands the cartridge to No. 1, passing outside the platform; he returns to his post, and places the cartouch box behind him.

Replace sponge—to rammer.

No. 2 replaces the sponge, seizes the rammer, and places it in the embrazure.

Load with cartridge.

No. 1 places the cartridge in the gun, a wad upon it, seizes the rammer, and, with the aid of No. 2, enters the rammer into the muzzle.

Ram home.

Nos. 1 and 2 ram the charge home with four equal strokes, draw out the rammer and place it on the parapet; Nos. 3 and 4 move to the epaulment; No 3 takes the wad, and No. 4 the ball.

The ball in the piece.

Nos. 1 and 2 receive from Nos. 3 and 4 the ball and wad, place them, seize the rammer, and lodge it in the piece.

Ram down.

Nos. 1 and 2 ram down by two equal strokes, withdraw the rammer, and lay it in the embrazure; Nos. 3 and 4 resume their posts.

Replace rammer.

The gunner of the left, takes his hand from the vent; No. 2 places the rammer in the rack; No. 1 sweeps the platform, and all resume their posts.

To handspikes.

As at the first word of command, Nos. 1 and 2 unchoke the wheels.

Embar.

Facing the parapet, Nos. 2 and 3 enter their handspikes behind the wheels, and Nos. 1 and 2, within the spokes; the gunner places himself behind the frame.

To battery.

The four matrosses act together to run the gun out.

Point gun.

The four matrosses change their handspikes; Nos. 1 and 2 embar under the first reinforce; Nos. 3 and 4 under the chassis, (or frame;) the gunner steps upon the frame, and points, the left leg advanced; the piece being in its required direction, he makes a signal with both hands, on which the matrosses unbar, and all

resume their posts. The officer examines the piece, and alters the direction if necessary.

Ground—handspikes.

As at the fifth word of command.

Prick—and prime.

The gunner pricks and primes, as before directed, and returns to his post; No. 3 seizes the pouch with the right hand.

To linstock—wedge.

Nos. 1 and 2 face the parapet; the others face outwards; No. 3, with the gunner, place themselves perpendicular to the exterior racks; No. 4 closes up on the gunner of the left.

March.

The gunner, and No. 3 and 4, leave the battery at the same time; No. 4 halts at the linstock, takes it with the right hand, rests it upon his left arm, and faces the parapet; when the gunner, and No 3, have arrived at the line in rear of the linstock, they face inwards, and halt when within 2 paces of each other.

Front.

The gunner, and No. 3, face the epaulment; No. 3 carries the pouch to its place, and then covers his file.

Linstock—march.

No. 4 advances to the right or left of the piece, according as the wind blows, (if to the right, he faces from the epaulment; he faces to it, if on the left;) the gunner moves to the epaulment to observe the effect of the shot.

Raise—match.

No. 4 strikes the linstock on his left arm, raises it, the arm extended (the nails upward) four inches above the tube, or the extremity of the train of powder; Nos. 1 and 2 detach the wedges.

Fire!

No. 4 touches the priming; withdraws it the instant the fire communicates; and always, towards the chase, returns the linstock to its place, and joins his file. No. 1 and 2 wedge the wheels on the recoil, and remain in their places facing the epaulment.

If the firing is to cease, a roll will be the signal for the gunners, &c. to resume their stations.

NOTE.

Three men may serve a gun mounted on a garrison carriage, by using a machine to stop the vent; in that case, two men load, and the third acts as purveyor; and to run the gun from

battery; the first time assistance could be obtained from the piece on the right, or left, and the three men are sufficient to run it out.

To stop the vent, General *Gassendi* proposes to make use of a stuffed pad, to which is suspended, on each side of the gun, a weight of 14 pounds—this is equal to the pressure of one man. Immediately after the gun is fired, this pad is put on the vent by the purveyor, previous to his going for ammunition; by this means, too, no risk is run, occasioned frequently by the indolence, inattention, and apprehension of the man who attends the vent. You might, to be sure, stop the vent by a spring, to which the pad is attached and fixed to the breech of the gun; but this would be liable to get out of order, and produce delay, whereas, there can be nothing more simple, and of more equal pressure, than what is proposed by General *Gassendi*.

EXERCISE OF GUNS ON SEA COAST CARRIAGES.

GUNS IN SEA COAST BATTERIES.

Five men are to serve a gun mounted upon this carriage.

1 *Gunner.*

4 *Matrosses.*

Nos. 1 and 2, two paces from the epaulment; Nos. 3 and 4, one pace from them; the gunner one pace from these.

THE IMPLEMENTS AND EQUIPMENTS, are:

On the left of the piece,

1 *Handspike*—Upright against the epaulment.

1 *Wedge*—In front of the frame (or chassis.)

1 *Sponge*, 1 *Rammer*, } On a rack.

— *Shot*—Near the epaulment.

1 *Linstock*, } In a socket, on a line with the frame, and one pace in rear of No. 4.

1 *Thumbstall*, 1 *Priming wire*, 1 *Priming horn*, } Carried by the gunner.

1 *Directing handspike*—In rear of the frame, (or chassis.)

On the right:

1 *Handspike*, 1 *Wedge*, — *Wads*, } Placed as on the left.

1 *Pouch for cartridges*—Behind No. 3.

1 *Broom*—Against the epaulments.

1 *Apron*, { Taken off by No. 3, and placed against the epaulment.

Words of command, as before described :

Gunners and matrosses, to your posts—March !

Front—prepare battery.

WORDS OF COMMAND:

To handspikes.

Nos. 1 and 2 take their handspikes.

Embar.

Nos. 1 and 2 embar in the mortices of the large roller ; they are assisted by Nos. 3 and 4.

Form—battery.

All heave together, until the handspike is within a foot of the ground ; Nos. 3 and 4 retain the piece, whilst No. 1 withdraws his handspike, and places it in the upper mortice ; No. 2 then does the same with his ; they heave together, and repeat this motion until the piece is run back sufficiently to be loaded ; Nos. 1 and 2 place the wedges under the roller, to check the piece, which, in the mean time, is supported by 3 and 4 ; they unbar, and return to their posts.

To the knob.

Nos. 1 and 2 pass their handspikes to 3 and 4, who, in facing out from the epaulment, embar under the first reinforce ; the gunner steps on the chassis, places the piece horizontally for loading ; Nos. 3 and 4 raising the breech, to facilitate the movement of the elevating screw ; the gunner makes the signal ; Nos. 3 and 4 unbar, deliver the handspikes to Nos. 1 and 2, and they all resume their posts.

Lay down handspikes.

Nos. 1 and 2 place their handspikes against the epaulment.

To sponge—stop vent—to cartridge.

The gunner steps on the chassis, stops vent with the right hand, No. 2 goes for the sponge, and with the aid of No 1, introduces it into the gun ; No. 3 holding the pouch in the right hand, moves to the extremity of the platform, and on the signal given by the man of the piece on the left, he repairs to the magazine for powder.

Sponge.

Nos. 1 and 2 turn the sponge several times in the bottom of the bore, draw it out, and place it against the epaulment; No. 3 advances, and hands the charge to No. 1; he remains in that position; No. 4 moves up to the epaulment.

Replace sponge—take rammer.

No. 4 receives the sponge from No. 2, replaces it, takes the rammer, hands it to No. 2, who places it on the epaulment; No. 3 seizes a wad.

Load with cartridge.

No. 1 puts the cartridge and wad into the piece, which he receives from No. 3, and assisted by No. 2, drives the charge home.

Ram home.

Nos. 1 and 2 ram the charge home with four equal strokes, draw it out and place it against the epaulment; No. 4 hands a shot, No. 3 a wad.

Shot gun.

No. 1 and 2, provided with shot and wad, place them in the gun.

Ram home

The charge is rammed home with two equal strokes; the rammer is withdrawn and placed against the epaulment; Nos. 3 and 4 resume their posts, after replacing the cartridge pouch.

Replace rammer.

The gunner descends from the chassis, No. 2 replaces the rammer; No. 1 sweeps the platform, replaces the broom, and all return to their posts.

To handspikes.

As before described; Nos. 1 and 2 withdraw the wedges.

Embar.

Nos. 1 and 2 embar in the lower mortices of the roller.

Run out gun.

Nos. 1 and 2 heave at the handspikes, to put the gun in motion; when the handspike is vertical, they take it out and insert it anew in the lower mortice, and continue this movement until the gun is in battery; they then resume their stations, retaining the handspikes.

Point.

No. 1, facing from the epaulment, embars under the first reinforce; No. 2 places his handspike against the epaulment, seizes the linstock, and places himself on the side from which the wind

blows; Nos. 3 and 4 move to the directing handspike; the gunner steps upon the chassis, clears vent with the right, primes with the left hand, and points the gun. He then springs from the chassis, and gives the word "*Fire!*" No. 1 unbars, replaces his handspike, seizes the wedge, and places himself ready to check the gun after it recoils. No. 2 then fires, places the linstock in its socket, and they all resume their posts.

In firing on a moving object, (a vessel,) it is necessary to execute the order "*fire*," immediately on its being given; it would, in that case, be better to have a match on each side of the gun, so that either No. 1 or 2 may fire, and avoid, by that means, a loss of time, if No. 2 were compelled to come round the carriage to fire the piece on the right.

TO FIRE UNDER AN ANGLE OF 45°.

If the case occur to fire under an angle of 45°, a hole made in the ground will easily supply the carriage; the breech is lodged, bearing upon a piece of curved timber, so as to form a semi circle, covered with old cordage; bearing the chase on joists, or other pieces of timber. Such a firing, having no other object than to frighten a timid enemy and deceive him on the distance, requires no rectitude, and may be imperfectly directed; if, however, new directions are necessary, a strong stake is planted in the rear, a prolonge is fixed at the gun's neck, and they turn it towards the new aim; then the timbers are again passed under the chace to support it.

13 INCH MORTARS.

There are five men to serve the 10, and 13 inch mortars, viz.:

1 *Bombardier*,

4 *Matrosses*.

Nos. 1 and 2 on each side of the carriage, abreast the front bolts of the bed; Nos. 3 and 4, in a line with the rear bolts of the bed; the bombardier one pace from No. 4.

THE IMPLEMENTS AND EQUIPMENTS, ARE:

On the left.

2 *Manœuvring handspikes*, placed on the platform, parallel to the bed, the but end towards the epaulment, the end of one near the middle of the other, those of 1 and 2 near the bed.

1 *Sponge and rammer*, placed upon 2 crotchets.

1 *Levelling coin.*

1 *Linstock.* in the rear.

1 *Quadrant*—against the epaulment.

1 *Pair of shell hooks*—opposite the middle of the bed.

1 *Priming wire*,
1 *Tube box*,
1 *Pair of sleeves*, } carried by the bombardier.

—*Shells*, (*capped*,) in the rear—near the line of linstocks.

On the right.

2 *Manœuvring handspikes*—placed as on the left.
1 *Levelling coin.*
1 *Ladle and scraper*,
1 *Sand bag*,
1 *Plummet*,
1 *Spatula*,
1 *Mallet*,
1 *Fuze-driver*,
—*Splints*,
2 *Stakes*,
Broom.
} contained in a basket on the right of the mortar, in the middle of the bed.

The word of command: *bombardier, and matrosses, to your posts—march—front*, is executed as prescribed above.

Prepare battery.

No. 2 takes out the tompion, or muzzle cap, and lays it against the epaulment; the others arrange the handspikes on the platform; the bombardier brings the basket, and places it behind; No. 3 distributes the implements as before stated, provides himself with the sleeves, priming wire, and tube box; the other articles remain in the basket, except the stakes, which he prepares to fix in the line of fire; he directs, for the purpose, one of the matrosses to go upon the epaulment, and place in the line he shall point out; the bom-

bardier in rear of the bed, gives the direction to the mortar, with the plum line.

If the mortar is not depressed, the bombardier and matrosses place it upon the fore bolster, as will be described hereafter; these dispositions being made, a roll is beat, and all repair to their posts, and the following orders are given:

To—handspikes.

The matrosses each take a handspike, and rise together.

Embar.

Nos. 1 and 2, embar under the front, and 3 and 4 under the rear, traversing bolts, the bombardier moves to the front, faces to the left, and places himself in rear of the bed.

To battery!

They all act together; the bombardier directing their movement to place the bed in the middle of the platform; the mortar being in a proper position, he makes a signal with both hands, on which they embar and resume their stations.

Lay down handspikes!

Nos. 2, 3, and 4, ground handspikes and rise together.

Clean mortar!

The bombardier passes in the rear of No. 4, and places himself before the mouth of the mortar; No. 2 takes the sponge; No. 3 the scraper, and sand box; they present these implements to the bombardier as he requires them; and they return them to their places when he has done with them; they then resume their posts, and the bombardier repairs to the left of the mortar, and faces it on a line with the trunnions.

Raise mortar!

No. 1 places his handspike under the chase; Nos. 2, 3, and 4, assist at the movement; they all have their backs turned to the epaulment; the bombardier seizes with his left hand the top of the mortar, and with his left, the handle; they raise the mortar perpendicularly on the bed; the mortar raised, No. 1 places a coin in front, and the bombardier, one in the rear, to keep it; the bombardier resumes his position facing the epaulment; he gives the signal, and the matrosses resume their stations; No. 1 retains his handspike.

To powder—to shell!

The bombardier faces to the right; No. 1 holds his handspike in the middle, the small end in front; No. 2 seizes the hooks;

they move up, and dress in a line with the bombardier; they are faced from the epaulment, and on a line with the men of the other mortars; on a signal made by the matross on the left of the battery, all the purveyors move off, at the same time, dressing by the right. Nos. 1 and 2 halt at the shells; No. 2 hooks on to one; No. 1 is in front, holding his handspike by the small end, in his right hand; No. 2 passes the hook over the handspike, and seizes it by the butt end; they move up and halt in a line with the linstocks, on the left of the mortar; the bombardier goes to the magazine, receives the cartridge, and places himself in front of No. 1.

Load—powder l

The purveyors repair to the battery, dressing by the right; bombardier steps upon the bed, and empties the powder into the chamber, and places the paper upon it; No. 4 hands him the rammer; replaces it when he has finished with it; Nos. 1 and 2, passing in rear of No. 4, place the shell upon the fore bolster.

Load—shell.

Nos. 1 and 2, assisted by 3 and 4, raise up the shell, and the bombardier seizing the hook with the right hand, causes the shell to be lowered gently into the mortar, detaches the hook, and gives it to No. 2, who replaces it; the bombardier fixes the shell so that the fuze is precisely in the axis of the mortar; No. 3 furnishes the bombardier with four splints, and the spatula, and returns them after he has done with them. The mortar loaded, the bombardier gives the signal, on which Nos. 3 and 4 seize the handspike, and the bombardier resumes his station on the left of the mortar.

Lower—mortar.

The four matrosses place their handspikes across the front of the mortar; No. 1 takes out the coin, and places it on the bolster; the bombardier passes in rear of the bed, holds on with the left hand to the muzzle of the mortar, takes out the coin with the right hand, and then seizes the mortar with the right hand at the handle. They lower the mortar gently upon the fore bolster; they all resume their posts, No. 1 retaining his handspike; the bombardier goes for the quadrant.

To handspikes.

The matrosses take up their handspikes, and the bombardier takes the quadrant, and takes post one pace in front of the mouth of the mortar.

Give degrees—point.

The four matrosses fall from the epaulment; Nos. 1 and 2, enter their handspikes under the mortar; 3 and 4, in the notches in the hinder part of the bed; the bombardier advances the left leg, places the quadrant on the mouth of the mortar, and gives the elevation required; Nos. 1 and 2, lower or raise the mortar as ordered. The mortar being elevated to the proper degree, the bombardier makes the signal for Nos. 1 and 2, to unbar and enter their handspikes at the notches in front of the bed. The bombardier is careful to support the quadrant in its place; he passes his left leg round to the left trunnion, the other on the right side; in this position he directs the mortar, which being pointed, he rises up facing the epaulment; he then directs the men to their posts, and, replacing the quadrant, he resumes his post, passing between the men on the left, and the mortar.

Lay down handspikes.

As before explained. The bombardier prepares the priming wire.

Prick—prime.

The bombardier advances the right foot opposite the rear traversing bolt, springs forward, on the left leg, pricks with the right hand; and, with the left, places the tube; rises on the right foot, and resumes his post. No. 3, covers the vent with the sand bag; No. 1, sweeps the platform, and they resume their posts.

To Linstock.

The bombardier and matrosses face from the platform, and advance in file to the end of the platform, a pace distant from each other.

March!

They advance, dressing by the right; No. 2, halts at the linstock; seizes it with the right hand; holds it in the hollow of the left arm; the others move on; arrived on the alignment, they face inwards, march toward each other, and halt when at one pace from each other.

Front.

They front the battery; the bombardier moves to the right, or left, of the mortar, to observe the fall of the shell.

Linstock—march!

No. 2, advances to the right, or left, of the mortar, according to the wind; he halts opposite the rear traversing bolt; if on the left of the piece, he faces the epaulment; and from it, if to the

right; he uncovers the vent, and places the sand-bag in the basket.

Raise—arm.

No. 2, strikes the linstock over the left arm; springs back the left leg; the weight of the body thrown upon it; the left knee bent, he presents the match, four inches from the tube, the right arm extended; the wrist lowered; the nails upward.

Fire.

No. 2, touches the tube; remains until he sees the fire has taken; after the piece has gone off, he rises; replaces the linstock, and resumes his post.

If the firing is to cease, the roll is beat, and the order is:

Bombardier, and matrosses, to your posts—march—front.

Which are executed as described.

The exercise finished, the following order is given:

To handspikes—embar—in battery,

(Which are executed as previously stated.)

Depress—mortar.

Nos. 2, 3, and 4, lay down their handspikes; No. 1, embars under the chace, assisted by the others, who place themselves at the extremity of the handspike facing from the epaulment; the bombardier seizes the upper part of the mortar with the left hand, and the handle with the right; the mortar is raised upright; No. 1, shifts his handspike to the other side, and with Nos. 2, 3, and 4, facing the epaulment, the bombardier draws the mortar down; it is supported by the handspike, until the handles rest upon the transom; they then resume their posts.

Dress handspikes—put in tompion.

The matrosses fix their handspikes on the traversing bolts; No. 2, puts in the tompion, No. 1, sweeps the platform; the bombardier puts the implements into the basket, which he has secured in the arsenal, at the same time, the order:

Right and left—face.

The matrosses move to the extremity of the platform, in double file, one pace distant, facing outward.

March.

They leave the battery—attentively preserving their dress.

Halt.

They halt until the bombardier returns, when he takes post in front of the left hand file.

They march in the same manner as they entered the battery, as before explained under the article : *exercise in batteries at a siege.*

EXERCISE OF AN EIGHT INCH MORTAR.

One bombardier, and two matrosses, serve an eight inch mortar.

The implements, &c. the words of command, and the exercise are the same as for the 13 and 10 inch mortars, except

2 *handspikes*, (and not 4, since there are but 2 matrosses,) the 2 matrosses furnish the bombardier.

The mortar is raised or lowered without a handspike.

No. 1, goes for the shell, brings to the right of the mortar, to hand it to the bombardier, who places it.

To point the mortar No. 1, embars in the notch in rear of the bed; No. 2, embars under the chase to give the degrees, and at the head of the bed, to give the direction.

SERVICE OF STONE MORTARS.

There are 5 men to serve this mortar of 16 inches, their duty and stations are the same as at the 13 inch mortar. The implements are also the same, except the *hooks*, the *spatula*, the *mallet*, the *fuze driver, splints and shells*, for these last, wooden wads over the powder, and baskets filled with stones are substituted.

The words of command, and exercise, are nearly the same ; differing only in the names of the articles substituted.

To load this mortar, the powder is put into the chamber, upon a wooden wad, then the basket filled with large stones. In case there is no basket, the mortar is filled with a layer of stones and earth, alternately.

OBSERVATIONS ON THE MANNER OF LOADING AND POINTING THIS MORTAR.

The powder being arranged in the chamber, the paper cylinder is flattened down upon the powder, covering it in all its space, and lightly pressed down with the rammer.

When the shell is placed in the mortar, in the manner prescribed, the bombardier secures it with 4 splints, one is placed under the shell, one above it, the other two perpendicular to these.

When the bombardier fixes the quadrant to obtain the elevation, it must be placed perfectly vertical, so as to correspond with the axis of the bore : he ascertains this point by means of the plummet, which, in its true position, must be parallel to the graduated part of the circle.

After giving the degrees of inclination to the mortar, the bombardier raises vertically the moveable index ; with his left hand he seizes the quadrant, and takes care not to derange it, in all the motions he makes in attending the mortar.

To ascertain that the mortar is in its true direction, the bombardier attends to fix the sight in a direct line with the two stakes, covering each other. If the quadrant has not a moveable index, the direction is obtained by the plummet ; to effect this, the bombardier posts himself one pace in rear of the bed, in the direction of the stakes ; he then ascertains that the sight passes through the line of the plummet, the sight at the breech, the quadrant, the sight at the muzzle, and the stake. To effect this, General *Gassendi* proposes to engrave two or three strong lines on the right and left of the vent, parallel to the axis of the mortar, and one inch distant from each other, the first passing through the vent to the muzzle ; by this means, the bombardier would obtain more accuracy, he being accustomed otherwise to level only by the vent ; and should the mortar be inclined, the vent ceases to be the superior point of sight ; he would, consequently, give a wrong direction to the piece.

A vertical line might be engraved on the breech, in the vertical places which is supposed to intersect the axis of the mortar, when on a horizontal platform ; on the superior part of this line a hole is pierced, through which a plummet line is sustained on the top by means of a small peg. You will thereby ascertain, whether the axis of the mortar is horizontal with its trunnions, and whether the vent divides the mortar correctly ; or if you should follow one of the lines of intersection.

To dispense with the quadrant altogether, you may trace two lines on the trunnions, one horizontal, the other vertical, at right angles, a quadrant of which must be divided into degrees. The piece being placed horizontally on its bed, you will mark upon the trunnion, well filed and smoothed lines, corresponding to the degrees and minutes ; by this means you obtain the degrees of inclination.

To throw a shell correctly, requires much more attention and intelligence than in the service of cannon.

In consequence of the shortness of this arm, it is very difficult to give it its true direction; for, however small the deviation of the shell from that true direction in leaving the mortar, its obliquity will be the more considerable, as its amplitude is greater; the degrees of elevation; the true charge; are both difficult to find; and when found, difficult to preserve. Many causes combine to produce uncertainty in its fire: the quantity, and quality of the powder never well proportioned; the shells differing in weight, in form, and dimensions; the construction of the mortar, its bed, as well as the platform, which, after the first fires, is inevitably deranged; the impossibility of placing the shell correctly in the mortar, so that the axis of the two unite, and both in the same line to the target: either of these causes will produce an astonishing variation in the flight of the shell. It is only by a good theory, by the strictest attention and exactness in practice, that you can ever hope to attain any skill in throwing shells.

MECHANICAL MANŒUVRES.

These powers, as applied to artillery service, are the means employed by the assistance of the lever, tackles, and sometimes of simple pulleys, to raise heavy weights.

The number of men necessary to manage the several calibers, is as follows: Four for 3 and 4 pounders; six for a 6 pounder; from eight to ten for a 9 pounder; ten to twelve for a 12 pounder, and for an 18, or 24 pounder, twenty to twenty-four men.*

FIRST MANŒUVRE.

MOUNT A PIECE ON ITS CARRIAGE IN A NARROW ROAD.

If the gun be overturned in a narrow road, where there is only room for its carriage to pass, raise the carriage, and place it in rear of the piece, which is raised perpendicularly on the muzzle, by hand if it should be a 4, or 6 pounder; but if a larger caliber, the prolonge is detached from the limber, and fastened to the button, in the middle, with a sailor's knot; a handspike is also fastened crosswise to the button, with a bricol; two or four men are stationed at this handspike, one behind the button, one at each trunnion, one hand seizing the handspike, the other the handle; the men haul forward upon the two ends of the prolonge; all being ready, the commanding officer orders:

Attention—steady.

The men act all together, and raise the piece on its muzzle.

From 4 to 6 men will be sufficient to keep it steady; the carriage is brought up, the head against the trunnions, the wheels are choked, the trail is raised to receive the gun, which is lowered

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* In the execution of the manœuvres, the greatest silence and attention must be observed; the slightest negligence or confusion, on the part of the men engaged, may produce serious consequences, which will not happen when every one acts with regularity and precaution.

These manœuvres are extracted from General Gassendi, and Hulot.

with great care into the trunnion plates ; the trail is then lowered, and the cap squares placed upon the trunnions.

NOTE.—The 12 pounder being longer, and more difficult to raise, this manœuvre might be facilitated, by digging a hole 18 inches deep under the chase, or by raising the breech with handspikes, and placing under it blocks, or large stones.

2d METHOD.

If it were a battering piece, that could not be raised up on the muzzle, to mount it on its carriage, the chase is raised by means of two handspikes placed crosswise underneath it, and square blocks or stones under the trunnions ; the limber is detached from the carriage, the trail is passed as far as possible under the chase, the two wheels are taken off, and a block is placed under each axle-tree ; place a roller under the chase, resting upon the flasks, another is placed under the first reinforce ; pass a handspike under the button, and four men place their handspikes under this, (two on each side of the button,) two men embar under the trunnions, and all acting together, move the piece forward ; two men, one on each side, embar under the chase, towards the muzzle, and assist in sliding the piece forward ; if there are men to spare, let them facilitate the movement, by fixing the prolonge to the piece, to drag it forward. When the breech of the gun is advanced as far as the trail transom, the rollers are moved forward, to facilitate the progress of the piece, until it is fixed in the trunnion plates. The wheels are successively replaced, by means of a lever, and a block (as a fulcrum,) which is placed under the head of the carriage, or the axle-tree, which, when sufficiently raised, take out the linch-pin, place a billet of wood under the axle-tree, and put on the wheel.

2d MANŒUVRE.

TO MOUNT, OR DISMOUNT A GUN, (by means of a manœuvre termed : *en chapelet.*)

You must have sufficient room to perform this manœuvre ; two large pieces of scantling, or poles, 12 feet long, and 4 inches

square ; a block of wood ; a double prolonge ; eight handspikes (16 men are sufficient for a 24 pounder ;) take off the wheel on the side of the piece, by prying under the head of the carriage, or axletree ; and lay it down, so that the end of the spindle may bear on the large opening of the nave, and keep it in this position, by replacing the linchpin in its hole ; fix one piece of scantling, one end bearing against the head bolts of the flask ; the other, under the chace of the piece ; one end of the other piece of scantling is fixed behind the trunnion plate, the other under the breech of the gun.

The prolonges are passed round the upper spokes of the wheels, the other ends are fastened to the nave ; the prolonges are then passed over the flasks, and a double turn taken round the piece, at the first reinforce, and at the chace ; two men with handspikes assist in prying up the piece, whilst the others haul upon the prolonges.

The officer perceiving that every thing is ready, orders :

Attention—steady.

The men act together, and raise the piece on the skids, until it reaches the flasks ; the trunnions are to be vertical, the under part of the gun next the carriage, so that by merely turning it, it falls into the trunnion plates ; the wheel is replaced as previously described.

The gun is dismounted by inverse means.

3d MANŒUVRE.

MOUNT A GUN ON ITS CARRIAGE, THE WHEELS SERVING AS A ROLL.

There is required for this manœuvre a piece of scantling six feet long ; three blocks ; four rollers ; eight handspikes ; one double, or three single prolonges ; 12 men are sufficient for a 24 pounder ; the scantling is fastened with the rope under the button of the gun ; the prolonges are fastened to each end of the scantling ; they are passed round the naves, passing them above, and next to the spokes, the ends passing beyond the carriage will serve as retreat falls ; raise the chase, crossing the handspikes under it ; the chace of the piece is raised upon the trail of the carriage, upon which a roller is placed to enable the gun to move with more facility ; the piece is pushed forward by means of handspikes, at

the same time recoil the carriage; two rollers are placed on the flasks under the piece, one near the trail transom, the other as forward as possible; the other rollers are placed under the flasks, one near the trail, the other at some distance; a handspike is entered into each handle, to keep the piece steady; these two men face outward, to prevent accidents, in case the piece should slide off; two men pry under the extremities of the beam, to assist and steady the movement; one man attends to changing the rollers, as the piece advances; two men haul upon the prolonges; two or three men advance the carriage, by prying with their handspikes between the spokes of the wheels. These combined movements are continued until the trunnions are near their plates; then by weighing on the chace, or raising it by cross handspikes to withdraw the roller, lodge the piece in its place.

This manœuvre is more easily performed with horses. Tackle them to the retreating hooks of the carriage; fasten the falls to the spokes of each wheel.

This manœuvre may be performed without moving the carriage, as follows: place two stakes against the trail; place a block under the head of each flask, to raise the wheels from the ground, so as to enable them to act as rollers; then, act as in the preceding case. In case you have no bearer to attach to the button, the prolonge would be fastened to it, as a substitute; but, then, you must take care it does not get loose from the nave.

Another method may be employed, still less difficult, and with fewer men, thus: fasten a limber without wheels to a stake, or tree, 12 paces from the head of the carriage; fix one of the limber wheels on the pintle, the bulge of the nave downwards; attach two handspikes, the butt ends against the small end of the nave, (a sapling may be substituted for the handspikes;) lash them tight to the felloes; fix one end of a prolonge to the chace of the piece, the other end passed twice round the large end of the nave, the retreat fall, held by one man; one man is placed at each handspike on the wheel, and by turning it, mount the piece on its carriage.

FOURTH MANŒUVRE.

MAKING STRAPS ROUND A WHEEL. (*Pans de Roue.*)

Take two half prolonges, or any similar ropes, fix one to each wheel, fasten them with a German knot, round the spokes and feloes, as near the ground as possible; and on the opposite side to the point you are going to, lay the ropes round the circumference of the wheels, man them with an equal number of men, and haul together. In case of a deficiency of men, make use of a limber in front, to serve as a roll, as directed above.

It may be necessary to make straps round a wheel, to extricate a carriage from a rut, or mud hole; the men pry under and behind the wheels with their handspikes, to lift them, and brace up against the wheels to prevent them falling back when the ropes are changed to a lower felloe, to continue the manœuvre.

FIFTH MANŒUVRE.

TO RAISE A PIECE TURNED TOPSY TURVY. (*versée en cage.*)

If in overturning, the piece is disengaged from the trunnion plates, it is raised up, by placing blocks under the chase and breech, and replaced in the trunnion plates, and the cap squares secured; both the breech and chase are then additionally secured with ropes to the carriage, to prevent its breaking loose; place yourself on the side you intend to raise it, fix the middle of a prolonge round the small end of the nave, and the two ends pass through the lower felloes; they are then passed over the piece and carriage, and through the inferior spokes of the opposite wheel; they are then brought back over both wheels, and extended to the rear their whole length; four men with handspikes embar under the opposite wheel and the flask near the trail. the rest of the men lay hold of the two parts of the prolonge. To prevent the wheel and carriage receiving too great a shock, brush or straw, is placed to receive it; every thing being prepared, the officer commands:

Attention—steady!

The men exert themselves, and move with spirit, because, if

the execution is slow, the lower wheel having a bad hold, and bearing all the weight, is liable to be very much strained.

SIXTH MANŒUVRE.

MOUNT A GUN ON ITS CARRIAGE OPERATING AS A SLING CART.

For a 24 pounder, from 20 to 24 men are necessary; two beams, 6 feet long, 5 inches square, a prolonge to raise and lower it, two pieces of rope for lashings, three traces, a roller, and eight handspikes.

Raise the breech, and place one of the beams under it; and, resting against the base ring, the but ends of two handspikes are placed under this beam, on each side of the gun, to keep it raised, for the purpose of lashing it to the piece; the beam must be firmly fixed, by crossing the lashing several times round the beam and the breech; the ends are passed within the handles, and fastened with a straight knot. To render the lashing as tight as possible, brace up the rope, twist the slack, put a tangle in, and secure it to the handles. Bring the head of the carriage near the piece, the wheels touching the beam; choke the wheels and lash them to the beam, passing the lashing round the felloe and the adjacent upper spoke; fasten the middle of a double prolonge to the lashing ring, leaving one end in the rear, and the other to the front; haul upon this end to raise the flasks perpendicularly, and keep them in this position, by holding on the ends of the prolonge to the front and rear; place the other beam through the upper spokes of the wheel, resting against the felloes underneath the flasks; pass the end of the prolonge, which was in front, to the rear, to haul down the trail. Two men, with handspikes, embar under the beam on the gun, two others under the front of the wheels, which are now cleared of the chokes, and the officer commands:

Attention—heave!

The men act together, and with care, haul down the trail, and when within their reach, seize it with their hands, to bring it down more easily to the ground; when the breech is raised from the ground, the men who were heaving under the beam, heave it to assist those in front of the wheels.

As the piece, by this operation, is only half mounted, the trail is raised, the beam under the carriage is unlashed and fixed as it was

at first; the wheels are choked, and the trail hauled down as before, which brings the gun home to the trunnion plates.

If a battering piece, a roller is placed across the head of the carriage forward of the chain bolts, to prevent the trunnions catching on them. To increase the power and prevent a shock, fix a prolonge to one end of a piece of scantling, the other end of this scantling under the trail transom, it then may act as a lever.

SEVENTH MANŒUVRE.

TO DISMOUNT A GUN BY SLIDING IT FROM ITS CARRIAGE IN FRONT.

Take off the cap squares, lock the wheels, press down the chace to lower the pointing plate, and screw; the large end of a handspike is introduced under the first, as near the trunnions as possible, and across both flasks; detach the prolonge from the limber, and fix it in the middle by a sailor's knot, to the button of the gun; pass the two ends to the front, equi-distant from the axis of the piece; four men raise the trail, to force the piece from the trunnion plates; if a 12 pounder, the trail is supported by two handspikes, the small end in the ground; two men steady the handspikes, holding them with one hand, and the trail hooks with the other; two men heave with two handspikes under the first reinforce, the rest of the men haul upon the prolonge. At the word "*attention—heave*," the men act together, and dismount the gun. In front of the carriage, the men leave their handspikes, and assist in lowering the trail.

EIGHTH MANŒUVRE.

TO DISMOUNT A GUN, BY SLIDING IT ALONG THE FLASKS, TO THE REAR.

In 24 and 18 pounders, 16 men are necessary, one prolonge, two gun traces, four rollers, (one small,) eight handspikes. Take off the cap squares, choke the wheels, the prolonge is passed through the upper spokes of the wheels, and through the handles of the gun; take two turns round the outer part of the naves, and one man holds on to each fall, rather in front of the head of the carriage; the two traces are fastened to the chace of the piece, the other ends making a turn round the felloe of each wheel, to support the piece. During its motion through the flasks of the car-

riage ; one man is stationed at each of these falls, to check the too rapid movement of the gun. Introduce a handspike into the muzzle, raise the breech, place a roller under it, beyond the base ring, then raise the chace with two crossed handspikes, and introduce a roller in the cap squares ; a man is stationed to attend to placing the rollers as the gun descends, and the piece is steadied by a handspike, fixed in the handles.

At the word :

Attention—ease off!

You raise the muzzle to put the piece in motion, and the men at the prolonge ease off handsomely.

A more simple method, and, perhaps, a better, would be to attach one end of the prolonge round to the swell of the muzzle, and take two turns round a stake driven into the ground in front of the piece ; the rollers are placed under the gun, as before, and the men ease off the fall ; the piece moves down the carriage without difficulty or accident.

NINTH MANŒUVRE.

TO RAISE A PIECE ON ITS CARRIAGE, WHICH HAS LOST A WHEEL.

Fasten a beam, 3 feet long, across the flasks, and above the breast transom ; take a piece of scantling, or a sapling 12 feet long, which is passed under the body of the axle-tree, where the wheel is missing ; one end on the ground, the other firmly lashed to the end of the beam, fixed across the flasks ; the carriage, thus arranged, proceed to mount the gun.

If the axle-tree was broke, substitute a stick of wood lashed to the flasks.

TENTH MANŒUVRE.

TO FIX A FALSE AXLE-TREE.

In case there should be no axle-tree at hand, construct one with elm, or ash ; let the spindle be similar to the broken one, and its body shorter, so as not to reach the opposite nave ; cut notches one inch deep to receive the flasks ; choke the wheels ; raise the carriage by means of a jack, or block, on a level with the remain-

ing wheel; take off the iron plates, (*equignon*,) and the understrap, (*hurtequin*;) saw off the broken spindle close to the shoulder; place the false axle-tree against the fore part of the broken one, and fasten them together with iron chains; pass a handspike through the last turn of the chain, and weigh upon it, until the two axle-trees are closely fastened, and secure the small end of the handspike, with a cord to the flasks, pole, or shafts. In case you have no chains, substitute ropes, &c.

For the axle-tree of a limber, drive wedges between the chains and the axle-tree, and secure them with nails.

ELEVENTH MANŒUVRE.

TO REPLACE AN AXLETREE WITHOUT DISMOUNTING THE GUN.

Secure the trail with strong stakes; place a jack under the head of the carriage, or against the retreating hook, on one side; raise the carriage, support it with a block of wood; raise the carriage on the opposite side, so that the jack abuts against the block of wood; you will take off the wheels and change the axletree.

TWELFTH MANŒUVRE.

TO DRAW A 24 POUNDER, OR HEAVY WAGON, OVER MOUNTAINS.

Drive into the ground a strong iron bound post, to which you fix a block—instead of a post, you may make use of a tree—a strong rope is passed through the sheave, and the other end fastened to the lashing ring; the end which is passed through the sheave is fastened to the tackling of the horses, which, by descending, will draw up the gun. This operation is continued until the piece is brought to its destination; 3 or 4 men are at the pole to direct the gun; 12 or 15 others assist with handspikes, to overcome any difficulties in the road.

If there should be no horses, a tackle may be fixed to the carriage of the gun, to which handspikes are lashed crosswise, from distance to distance, for the men to haul upon; by this means, 200 men may draw a 24 pounder over a steep hill.

Should a greater power be requisite, it can only be obtained by

the employment of compound pullies, with double or treble blocks.

THIRTEENTH MANŒUVRE.

TO LOWER A GUN FROM THE TOP OF A HIGH MOUNTAIN.

If the descent is not too steep, two horses are put to the carriage to direct it; or four men at a handspike, fixed as a cross bar, at the end of the pole. A post, or strong stake, capped with iron, is fixed in the ground, (should there be no tree convenient,) a rope is then fastened to the trail hooks, and two or three turns taken round the stake, and one man eases off, until it reaches the bottom of the mountain. It is understood that this operation must be repeated at every winding of the road, or whenever the rope gives out; and the locking of the wheel must be changed, that the tire may not be too much worn in the one spot.

FOURTEENTH MANŒUVRE.

TO PASS A GUN FROM THE CHARIOT-PORTE CORPS,* ON ITS CARRIAGE, OR TO REMOVE IT FROM ONE CARRIAGE TO ANOTHER, OR FROM ITS CARRIAGE TO THE PORTE-CORPS.

This manœuvre requires 12 men for a 24 pounder; 2 pieces of scantling, 12 feet long; 4 blocks of wood, 2 feet long, or for want of them, large flat stones; 4 rollers, (one of them small;) 1 prolonge; 2 traces, and 8 handspikes; unhook the shafts, pry up successively the breech and chace, and place 2 rollers under the piece; fasten a prolonge to the swell of the muzzle, and a trace to the button; bring up the trail, and place it under the hind axle-tree of the chariot, until the wheels of both carriages come in contact; they are then all choked; the blocks are placed upon the body of the axle-trees of the two carriages; on these blocks the two pieces of scantling are placed, the ends of them supported against the shafts, and the corresponding flasks, taking care that those which are on the axle of the gun-carriage are something less ele-

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* *Chariot porte corps*, is a wagon upon four wheels, for the transportation of heavy ordnance, (not mounted.) T.

vated than that part of the flasks in rear of the trunnion plates, and the scantling is secured with cords to the flasks and shafts.

To prevent a shock, from the piece sliding off with too much rapidity, pass a turn of the brace which is fixed to the buttons round the bolster, and ease it off gradually.

A man is stationed to change the rollers, as the piece leaves them; another steadies the piece with a handspike, passed through the handles; and two others, on each side of the carriage, with handspikes, aid the piece in sliding over the rollers, or by prying under the chace, or breech of the gun; the short roller is placed in the trunnion-plates.

The remainder of the men lay hold of the prolonge, which is fixed to the muzzle; at the words: *attention—heave*, which is given when every thing is ready, the men heave together, with care and attention, until the trunnions are near their plates; they are now moved into their place, resting upon the roller in the trunnion beds, press down upon the chace, and place under the breech a square block, raise up the chace, and take out the roller in the trunnion plates, let the trunnions fall into them; and, finally, you press down the chace to take out the square block under the breech.

Note.—Were it necessary to remove a piece from its carriage to the chariot, or change it to another carriage, the arrangement and execution would be absolutely the same; three men might be stationed at the gun, to slide it over the rollers, instead of using a prolonge.

FIFTEENTH MANŒUVRE.

PASSING A RIVER WITH THE GUN ON ITS CARRIAGE.

If there should be time, and the means, sound the bottom of the river, and select the most proper place, both for the evenness of the bottom, and the slowness of the current; should the banks be steep, slope them off on both sides, secure the carriage to the limber, attach two double prolonges together, (or a cable,) if the breadth of the river should require it; having fastened one end of the rope to the pintle, take a turn round the axle-tree of the lim-

ber, and the trail transom, coil up the remainder of the rope, and place it in a boat, with a gin, a mallet, stakes, handspikes, and any other implements which may be requisite; pioneer tools to level the opposite bank; pay out the warp as the boat proceeds, land the implements on the bank, and the end of the warp is held on to by 2 or 3 men; select the most proper place to fix the gin, and equip it, as will be explained hereafter; 4 or 5 men are left with the piece, six paces in its rear a stake is fixed in the ground, a prolonge is fixed to the advancing head hooks, two or three turns are taken round the stake, the slack is held on by one man, who eases off gradually, to prevent the piece moving too precipitately down the bank.

The other two men will double a piece of rope, and make it fast in the middle to one of the shafts, or the pole of the limber, they will twist the two ends, and in the middle of the thrill, will take in the warp, and continue twisting the rope until it is made fast to the other shaft. (This is for the purpose of keeping the warp in the centre of draft.)

The men on the other side will haul upon the warp, and the men at the stake, ease off handsomely, until the piece reaches the river; the warp is then fixed to the roll, and the men heave until the piece arrives on the opposite bank, in case of its being too steap, and the roll should not contain sufficient power to draw it up, assist it by the operation of the 4th manœuvre.

To facilitate the passage of a gun through very deep rivers, it may be buoyed up with empty casks, fixed on each side of the gun, or carriage; they must be perfectly tight, and of equal dimensions.

SIXTEENTH MANŒUVRE.

TO RAISE A GUN FROM THE BOTTOM OF A RIVER.

A grappling iron, (*ecrevisse*,) (such as is employed to raise heavy stones or beams by the assistance of the crane,) is used for this purpose. It has two small rings placed on each branch, a little below its diameter; to these are fastened two pieces of one and a half inch rope; the other ends pass through an eye at the bottom of each branch, which are curved outwards for that purpose. By holding on these ropes, the grappling is kept open; it is closed by

means of a chain, with four links, which are connected by a large ring, 4 or 5 inches diameter, placed in the centre. The links of this chain pass through holes at the end of each branch ; a strong rope passes through this ring, and the two ends are fastened with a knot, or spliced ; this rope must be long enough to reach the bottom of the river, from the hooks (*echarpes*) of the gin ; a small line is also fixed to the ring, for the purpose of keeping the grapling closed, until the whole is fixed for working at the roll.

SEVENTEENTH MANŒUVRE.

TO CONSTRUCT A BRIDGE FOR EQUIPPING THE CHEVRE, TO TAKE UP THE PIECE.

Construct a flying bridge by lashing two boats together, 8 feet apart, with 4 strong ropes, two of which cross each other diagonally, and the other two securing the extremity of the sides to each other ; two beams are placed close to each other, at each end ; they are fastened by clamps ; lay 4 smaller beams across the pontoons, so that their ends do not pass the interior gunwale of the pontoons more than 6 inches ; these are covered with chesses, made of thick plank ; fix the gin, its two legs resting upon one bridge, and the prop upon the other ; the gin is equipped with a block, single, double, or treble, according to the weight to be raised. There not being sufficient room on the bridge for many men to work, four or five turns of the cable must be taken round the roll, that two men may be able to hold on the fall.

The grappling iron, 6 handspikes, 2 skids, 10 feet long ; 6 boat hooks, and 12 men, are placed upon the bridge ; 4 men are posted fore and aft of the pontoons, to manage the bridge ; 4 to work the roll ; 2 at the fall, and 2 to manage the gun when it is raised.

Should the river be rapid, moor the boats, or fix them to the shore with a cable, raise the chesses, and lay them against the legs of the gun, until there is sufficient space for the grappling, and the piece to pass.

Having ascertained the place where the gun lays, the bridge is brought up and moored parallel with the gun, and the gin directly over it ; lower the grappling, and hook the gun behind the trunnions ; hook on to the gin tackle, take the number of turns ne-

cessary round the roll, and heave up ; fix a boat hook in the muzzle of the gun, to steady it in raising. The piece being drawn up about one foot above the surface of the bridge, replace the chesses, and fix the skids across the bridge to receive the piece.

EIGHTEENTH MANŒUVRE.

DRAWING WITH DRAG ROPES. (*A la galere.*)

This means is employed to draw carriages, heavy burthens, &c. at short distances, where there is a deficiency of horses, or a difficulty in making use of them. To manœuvre this rope galley, fasten the middle of a double prolonge, or piece of cordage, to the pole or shaft ; fix as many handspikes as may be deemed necessary, 3 feet asunder, in each part of the prolonge ; they are fixed in a loop, and the last one with a German knot ; secure them so that they cannot slip ; leave five or six feet loose at each end, for one man to draw by, passing it over his shoulder ; place three men to each handspike, one in the middle and one at each side of the handspike, which they hold in the hollow of the arms, at the height of their breast.

The first handspike is fixed about two feet from the end of the pole, to enable the men stationed at this handspike to direct the limber.

NINETEENTH MANŒUVRE.

TO LOAD THE SLING CART. (*Triqueballe.*)

The sling cart is composed of a tongue, the hounds, (*empanons,*) the axletree, the bolster, and two large wheels.

The sling cart is worked by hand, with drag ropes, (*a la galere,*) or with horses put to a limber, which is fastened to the end of the tongue.

To load the sling cart properly, it must be brought over the weight to be slung ; if, for example, a 24 pounder, or any other piece of ordnance, the chace must be forward of the axle-tree, and the trunnions under it ; choke the wheels, fix the middle of a

prolonge to the end of the tongue, raise it up, and keep it steady, by holding on the two parts of the prolonge.*

Pass a rope† doubled under the pole, between the guides, and over the bolster; pass both round the piece to be raised, and fasten them with a knot; or take a turn round the guides, pass them again round the bolster, and take a hitch round the parts which support the piece; its weight will taughten them; lower the tongue, which raises up the weight; if a piece of stone, or any other long square body, you will make it fast to the pole; a man follows with a handspike, to disengage the object from any obstruction.

To detach the burthen, disengage it from the pole, raise up the pole, and the weight lowers itself.

It requires 12 men to transport a burthen of 2000 pounds, and 26 men for a 24 pounder, on a plain.

A limber may serve to transport articles which are not of extraordinary weight; it is equipped in the same manner as the sling cart; two are sometimes made use of; the weight is then placed between them; one in front, the other in the rear.

TWENTIETH MANŒUVRE.

TO MAKE A SUBSTITUTE FOR A CAPSTAN.

A capstan is composed of two perpendicular cheeks, two crossbars, and a roll; over which passes the cordage; and the weight is put in motion by handspikes heaving upon the roller.

The substitute is a tree, not far distant, and opposite the weight to be moved; should there be no tree near, two posts are erected; they are kept in their perpendicular position by ropes; you adapt a roller to them, (see 25th manœuvre.)

2d Manner. Place two pieces mounted on their carriages opposite each other, distant the length of the nave, of which, from each other, pass through the nave a roller, or strong handspike, the ends of which enter into the muzzles of the guns; lash 4

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* The pole may be raised with more ease, by two men assisting with their handspikes in heaving under each guide, making the bolster the fulcrum.

† A chain is often used instead of ropes; it has a hook at one end; which, after the chain is fixed round the gun, is fastened to the upper links.

handspikes to the wheel, the buts resting upon the small end of the nave, fix a rope to the weight, and pass the other end round the large part of the nave ; two men hold on at the fall, and four are stationed at the handspikes.

The gun on the side of the rope, is further off from the wheel than the other, that the rope may not so easily slide off from the nave.

If there are no men for the fall, pass it through the spokes of the wheel, and fasten it to the part round the gun.

If there should be but one gun, raise the chace, secure the breech to the carriage, and fix a wheel in the manner described, one end in the muzzle of the gun, the other fixed to a post.

Should two trees be conveniently placed, cut notches in them at a proper height, for the end of the axis to rest in.

You may also make use of a wheel, placed upon the pintle of a limber, taking off the wheels.

Finally, there being a tree near, fasten one end of a prolonge to the weight, make two loops, four or five feet from each other, the first near the weight; through this, pass the other end of the prolonge, then through the other, and bring it back to the weight ; a man holding both ends, draws them taught; the double part is extended to the tree, and a lever, 14 or 15 feet long, is passed through the bite in rear of the tree ; heave upon the lever, by turning round the tree ; after the first of the prolonge is round the tree, place a roller under it, and then another, as the turns increase. When the lever has made a complete revolution of the tree, choke the weight, shorten the prolonge, hauling on the end which is passed through the loops, take a new purchase as before, and proceed.

TWENTY-FIRST MANŒUVRE.

ON THE GIN, AND THE VARIOUS MODES OF EQUIPPING IT.

The gin is a machine to raise heavy burthens, viz. : all kinds of ordnance, to move, or remove them to, or from any situation ; it is composed of two legs, fastened at the top by an iron band, called a cap ; two bolts, to one of which is a half ring, to which the pul-

lies are fastened; the legs are kept at a proper distance by three cross bars, and secured by hooks and staples; between the second and third bar, there are cross stays to enable the men to ascend; a roller, and a prop to the two legs; they are all shod with iron points.

There has been a new gin invented by Lombard, which differs from the other only by its roller; it is, however, but little in use; it will be spoken of hereafter, as well as the sham gin, (*chivre postiche.*)

There are three modes of equipping the gin: 1st. When upright on its three legs; 2d. With stays, the prop being wanting; 3d. As a capstan, when laid horizontally, and secured by pickets.

Ten men are required to work the gin, one of whom superintends the manœuvre, and keeps the weight steady.

The gin is equipped either before, or after it is raised; the latter is commonly the case, when you are obliged to use it during the day, in a battery exposed to the fire of the enemy.

The following is the mode of transporting the gin: 2 men seize with one hand the first cross bar, and with the other the foot of each leg; a third, opposite the middle of the same bar, seizes it with both hands; two others, abreast the second cross bar, seize it with one hand, and the leg with the other; two others support the head of the gin upon a handspike; one is charged with the prop, and two others with the tackle.

To raise the gin, and prevent its slipping, two men steady the legs with their feet; six others raise the head of the gin, assisted by two others, who support the gin as they raise it, with each a handspike; when high enough, the prop is fixed in the notch, at the head. The two legs and the prop must be equi distant; there must be 10 feet between them, so as to leave a free passage for the gun, or the carriage which is, or is to be, loaded with it.

MANNER OF EQUIPPING THE GIN WHEN RAISED AND SUPPORTED BY ITS PROP, AND NECESSARY TACKLE.

The gin may be manœuvred with from one to six ropes; the equipment necessary for this last number of ropes is: one cable; four traces, or pieces of rope; two simple pullies in iron strapped blocks, with a hook turning in a swivel; two double, or treble

pullies, (beside the one at the head of the gin ;) also five handspikes.

THE GIN EQUIPPED WITH A SINGLE BLOCK.

Enter a handspike in one of the mortices of the roll, to enable a man to ascend as high as the block of the gin ; the handspike is then removed ; the cable is then placed to the left of the roller, passing one of the ends of it to the right ; take three turns round it, the turns not doubling on each other ; a man on the second cross bar receives the end of the cable, passes it through the right sheave, and brings it down to the weight. If the weight be a gun, you form a sling, by passing a rope through the handles, and secure it with a simple knot ; fix the end of the fall to it, and heave at the roller. The sling might be dispensed with, and the end of the fall secured to the handles of the gun.

WITH A DOUBLE BLOCK.

Proceed as in the preceding manœuvre, as far as fixing the fall to the gun ; instead of that, pass the fall through the sheave of an iron strapped block, and hook on the sling ; the end of the fall is then passed round the head of the gin, passing it to the left, that the gin may be uniformly loaded.

WITH TRIPLE BLOCK.

Proceed as for the double ; but instead of capping the gin with the end of the fall, pass it through the left sheeve, on the same side as the other, viz. : from without, that the fall may hang between the gin and the prop ; the end of the fall is made fast to the handle, on the side of the prop of the gin ; and you hook on to the other handle, the stock of the hook outside.

WITH FOUR ROPES.

As in the preceding ; but instead of making fast the end of the fall to the handle, pass it through a strapped block, and hook on to the handle nearest the prop and the fall ; cap the gin to the left with the fall.

TO EQUIP THE GIN WITH FIVE ROPES, (OR PULLIES.)

Proceed as in the preceding case; but as there is commonly but 2 sheaves at the gin's head, weave a chaplet with two gun traces, which fix over the cap of the gin, to which, hook on a strapped block; pass the end of the fall through this block, and make it fast to the handle, on the side of the prop, and the tackle to the other.

WITH SIX ROPES, (OR PULLIES.)

Instead of fastening the end of the fall to the gun, pass it through a strapped block, which hook on to the handle; and make fast the end to the cap of the gin.

In equipping the gin with 5 or 6 pullies, the strapped block which is suspended at the head of the gin, must be between the left leg, and the prop, and the fall must be made fast to the right of the prop; particular care must be taken that the tackle does not get foul.

The gin is seldom equipped with more than four pullies, as it would require too much time, and six men can lift the greatest weight which is generally found in the artillery.

TO WORK THE ROLLER.

The gin being equipped, 10 men are stationed as follows: one non-commissioned officer as chief, is provided with a handspike, the butt end of which he introduces into the muzzle to steady the gun, so that it does not jam, or strike against the legs of the gin; should it be any other weight but a gun, a rope must be fixed to it for the same purpose.

Four men with handspikes placed on the right and left of the gin, facing inward one foot from the cross bar, holding the handspikes (towards the middle) vertically, the butt resting on the ground.

Two men destined to assist these in case of necessity, are posted one pace in the rear.

The three remaining, man the fall; they must exercise all their strength to prevent the cable slipping.

Every one being at his post, the non-commissioned officer commands:

Embar!

The two men nearest the roller raise their handspikes vertically, seize them with the left hand, six inches from the butts; the man on the right places his right foot, he on the left his left foot, on the cross bar, they enter their handspikes as far as possible into the upper holes of the roller, slide their hands to the small end of the handspike; the two men behind them, advance one pace to the front to support them; they raise their handspikes; the one on the right gives the word:

Heave!

The men at the roller, heave until their handspikes are a little below the horizontal line; the body firm; the heels close; the hands near the extremity of the handspike; the other two enter their handspikes in the upper holes; the one on the right gives the word:

Fetch!

Upon which the other men clear their handspikes, hold them perpendicular, and resume their first position; the one on the right gives the word:

Heave!

Those at the roller then bear down their handspikes, as before described, and so on, alternately, until the weight is raised, or assistance is necessary; in this case, the man at the handspike commands:

Assist!

The two men for this duty move forward, facing outwards, the fall being between them, mount on the cross bar, seize the handspikes with both hands, and aid to heave.

Should the weight be greater than the power, it must be increased as follows:

The two men who have entered their handspikes, place the outer foot on the roller, outside of their handspike, and the other foot against the second cross bar; at the *heave*, they throw the whole weight of the body on the handspikes, and heave with all their strength; they are assisted by the others, if necessary.

If there were but four men to work the roller, and the weight to be raised was considerable, the two first having entered their handspikes; the one on the right commands:

Assist!

On which the others lay down their handspikes, and assist the others; having hove down, the two second take up their handspikes, put them into the upper holes, and the two first lay down theirs, and assist at the word "*heave.*"

TO SECURE THE FALL TO THE SECOND CROSS BAR.

After manœuvring some time, the cable is apt to slide from the left to the right of the roller, and to move it back to its place, the fall must be fastened to the second cross-bar, as follows: A man mounts on the roller, and passing a trace round the cross-bar, makes it fast to the fall, and secures the two ends with a knot; the men at the handspikes raise them gradually until the fall is right against the bar; the cable round the roller now becomes slack, and is easily moved back to the left; the fall is then let go, and the manœuvre continues as before.

The weight being at its proper height, the fall is secured in the following manner: two handspikes are put into the upper holes of the roller, and a third is placed between them and the legs of the gin, to steady it; the man on the right holds on to the fall, and the man on the left forms a loop in the fall, a little below the cross-bar; he then introduces the large end of his handspike through the loop above the cross-bar; which being supported by the cross-bar and the roller, keeps the weight steady and secure.

The fall being secured, the non-commissioned officer remains at his post; the others move up the carriage under the gun, and resume their posts; two men unfix the fall with the same precaution which they observed in securing it; one man on the left, assisted by one on the same side, enters his handspike horizontally, bears down upon it, until the handspike which crosses the two others is disengaged by the man who has charge of it; he also puts it horizontally into the windlass, and gives the word "*assist,*" which is attended by the man on the right, whose duty it is; the men disengage the other handspikes from the windlass, and prepare to enter them horizontally, as the holes of the windlass present themselves; when entered, the man on the right gives the word "*assist,*" when the men let go the upper handspikes, to assist at the lower ones; they thus continue to ease off, until the weight is placed upon the carriage.

TO MOUNT A GUN WITHOUT A STRAP-BLOCK.

Take a roller about 2 feet long, perfectly round and smooth; secure it firmly across the dolphins with gun traces, or other ropes, and fastened with good knots; equip the gin as usual, and pass the cable round the roller, and heave at the windlass.

TO RAISE A PIECE WHICH HAS NO DOLPHINS.

Equip the gin with the tackle necessary to raise the piece, fix a strong handspike in the gun, attach one end of a stout rope to the button of the piece, then take a turn round the handspike, back again to the button, and so on several times, until the sling is strong enough to hold the weight; hook on to this sling nearly in the centre, so that the gun may be in equilibrium.

This mode of fixing the sling prevents the inconvenience which would arise from wrapping it round the gun; as in this case the piece could not be placed on its carriage.

TO EQUIP A GIN WITH STAYS.

The gin having no prop, or pry-pole, is supported by stays, if it become necessary to raise a weight to a considerable height, such as a gun from a deep ditch on a rampart. The stays are made of stout rope, or of double or single prolonges; the usual length of the single prolonge is 36 feet, the double 72 feet.

More men and more implements are required than usual, particularly to raise a gun from the bottom of a ditch upon the rampart, or from the foot of a tower to its platform.

Three men are employed to fix the cable and tackle to the dolphins, four strong pickets five feet long, to fix the stays to a mattock to drive the pickets; an additional cable, should the ditch be deep, one double, and one single prolonge; two lashing ropes, one pick axe handle, and two large blocks of wood.

To raise a gun from a deep ditch, with two cables, and place it upon a rampart, you proceed as follows:

You determine first, where the pickets that are to support the stays are to be placed: 24 feet perpendicular from the centre of the gin, were it erected, must be marked off; twelve feet to the

right and left of this perpendicular line, two of the stakes are to be driven down ; the two others are driven down six feet in rear of the first, in the direction of the foot of the gin, which are about two feet from the scarp ; lay down the gin, the foot of the legs towards the weight to be raised ; the cable is placed in rear of the head of the gin, one end is passed under it through the right pulley, and led along towards the middle of the gin ; the second cable is passed through the left pulley.

Make an artificer's knot in the middle of a double prolonge, and pass it over the head of the gin ; the ends of this prolonge, (which are to serve as stays,) are led by two men, and a double turn taken round the pickets they are to be fastened to ; the gin is then set up, and the stays are eased off, so that the gin may be a little inclined towards the weight, on account of the elasticity of the rope, which will stretch in proportion to the weight it has to support. The officer ascertains whether the stays have an equal strain ; if the gin is properly placed, the stays are then secured to the four stakes ; by this means the two inner stakes are less liable to be drawn out.

The gin being well secured, the right cable is passed (three turns) round the windlass, so that the fall be on the left ; the strap-block is fixed to the other end, and lowered into the ditch ; the two ends of the other cable are also lowered ; the men near the gun unties the strap-block, and pass the end of this cable through the sheave, and then fasten it to the end of the cable passed through the right pulley ; leave about ten feet slack to each cable ; pass a piece of stick through the knot to prevent its closing too tight ; the same men fasten a prolonge to the chase, and a trace to the button of the gun ; they finally hook on the block, and make fast the cable, as previously stated. The men at the gin make fast a block to the third cross-bar, and work at the windlass until the knot in the cables is as high as the right block at the head of the gin ; the windlass is then secured with handspikes, as before described ; a man makes one end of a single prolonge fast to the head of the gin, he lets fall the other end, which is laid hold of by another man, who makes an artificer's loop, through which he passes the slack of the cable of the left block, as high up as the knot which unites the two cables ; he passes a handspike through the loop, which he twists round, and makes fast, to prevent the knot from slipping.

Ease the fall; the man at the head of the gin unties the knot which unites the two cables, and draws out the end, which passes through the right block, the slack end of the other cable; fasten the cables again in the same manner as before; heave at the windlass until the cable is taught; the half prolonge is untied, and the man descends from the head of the gin; and the manœuvre continues until the gun is as high as it is intended to raise it; a man seizes the prolonge fixed round the chase, and hands the end to another who stands on the windlass; he passes it through the block which is hooked to the third cross-bar, and takes three turns with the slack round the windlass, and passes the fall to the rear; the first cross-bar is unhooked; a man seizes the rope at the breech of the gun, and hauls to him to bring the gun under the gin, as they heave at the windlass; a roller is then placed under the breech, and they continue to heave, until the chace is supported by the prolonge running through the block at the third cross-bar; taking care to ease off the cable when the breech is sufficiently advanced on the roller, and the chase is entirely supported by the prolonge; the tackle is then unfixed from the dolphins of the gun; and you heave anew at the windlass, until the gun is over the spot, where it is to rest. If you intend the gun should pass through the embrazure, the gin must be set up in it.

Note—It will be unnecessary to unhook the first cross-bar if the gun is not to arrive breech foremost; when it is one foot above the parapet, you pull upon the ropes at the breech, and chase; and you ease off the fall, until the piece is on the parapet, parallel with the ditch.

FIX THE GIN, AS A HORIZONTAL CAPSTAN.

The gin is laid flat upon the ground, to move a weight in a horizontal direction; the gin is placed on its curve, the feet towards the weight; raise the gin, by placing blocks or stones under the head and legs, to facilitate the movement of the roll; it is secured to three strong stakes, driven into the ground at the angles of the gin; should these not be sufficient to sustain the weight, two others are driven down between the gudgeons of the roll and the 1st cross bar; one end of the cable is made fast to the weight, the other is fixed to the roll; and the manœuvre is carried on, as when the gin is set up.

TWENTY-SECOND MANŒUVRE.

EMBARKATION OF PIECES OF HEAVY ORDNANCE, BY THE PRECEDING MODE.*

Fix and secure this gin as described; two pieces of scantling, cut slanting at one end, will serve as skids to roll the gun on; they are placed from the shore to the gunwale of the boat, the slanting side uppermost; two other pieces for the same purpose are placed in the boat, one end on the gunwale, the other in the bottom, resting against one of the timbers, to prevent the shock driving it through the bottom; the piece is then placed upon the two first skids; in the mean time, the boatmen will make the necessary preparation to receive the gun.

Make one end of a double prolonge fast to the stake and one of the legs; then take two turns round the gun, behind the dolphins at the first reinforce, passing it under the piece; bring it back, and fix it round the roll, as described in the former manœuvre.

With a single prolonge secure the other leg to the stake in the same way, then take one turn with it round the chace; five or six men hold on to the end; this rope is kept tight in proportion as they ease off the other round the roll.

Two handspikes are placed in the roll; they bear against the 2d cross bar, to prevent the roll from turning; two or three men at the fall, ease it off, as the piece is rolled on, until it arrives on the gunwale of the boat; a man then places his hands flat upon the turns of the rope round the roll; the fall is eased off gradually, until the piece is safely lodged in the boat. The gin is fixed in the same manner for disembarking, and the manœuvre is the same as in the other case.

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* This is understood only for embarkation on board of boats; on board of vessels, it is under the direction of the ship's crew, who are better provided, by means of tackles, &c.

TWENTY-THIRD MANŒUVRE.

EMBARKATION OF ORDNANCE WITHOUT GIN OR CAPSTAN.

Fix two stakes six feet apart, opposite the boat, and parallel to its length ; fix skids as in the preceding case, and the piece upon them in the same manner ; make fast one end of a double prolonge to the stake opposite the breech, take a double turn round the first reinforce, passing it over the gun, then take two turns round the stake with the fall ; one man seated at this stake, and easing off the fall, will prevent the piece falling too suddenly, and by that means injure the boats ; a rope is fastened to the other stake, and passed round the chace ; the fall is held by 3 or 4 men, who ease off as required.

If there are men enough, it will not be necessary to take a double turn round the stakes.

Ordnance may be landed in the same manner, without gin or capstan.

TWENTY-FOURTH MANŒUVRE.

LOMBARD'S NEW GIN.

This gin, like the other, is composed of two legs, 16 feet long, joined by 3 cross-bars, and a prop ; it only differs in the form of the roll, and blocks ; the roll is divided into two cylindrical parts of equal length, but different in thickness ; their diameters are in the proportion of 9 to 7 ; it is applied to the gin by staples, to receive the gudgeons, which are fastened to the legs with four screws ; at each extremity of the roll, are two mortises for the handspikes ; they intersect each other at right angles.

At the head of the gin, between the two legs, two blocks are fixed ; a bolt serves both as an axis ; this bolt runs through the legs, and is secured with a key ; this gin is fixed, by making fast one end of the cable to the middle of the roll, passing it round the small cylinder, until it is entirely covered ; the turn must be taken underneath, from without to within ; the cable is then passed through the corresponding block, at the head ; bring it down and pass it through an iron strapped block, which is hooked on to the weight ; the fall is then passed through the other block at the

head of the gin, and made fast to the middle of the roll on the large cylinder, round which it winds itself in a contrary direction when the gin is worked ; it is essential the fall should be extended as much as possible, so that the weight may begin to ascend, as soon as you commence heaving ; the roll being eleven inches in its greatest diameter, only 16 turns are necessary to raise a 24 pounder on its carriage ; allow sufficient length of rope to make 21 turns round each cylinder ; the rope is four inches ; with two iron levers, 1 1-2 inch thick, and 5 feet 3 inches long, weighing each 35 pounds, one man at each, can raise a 24 pounder weighing 5,300 pounds, and fix it on its carriage in 19 minutes.

When the roll stops, the piece remains in equilibrium ; this is the principal advantage of this gin.

TWENTY-FIFTH MANŒUVRE.

A TEMPORARY GIN, (*chèvre postiche.*)

When you have no gin, or one too weak for the weight to be raised, you substitute a temporary gin, supported by stays ; take two poles, or pieces of scantling, from 15 to 20 feet long, and sufficiently strong to sustain the weight. These pieces are crossed at the upper, or small ends, to form the head of the gin. The two larger ends, or the feet, being then spread out, distant from each other about half their length, lash the two small ends securely together, one foot from the tops ; this lashing must be made horizontally round the pieces, and again crossed vertically ; to this last, fasten two double blocks, set up this gin in the manner before described, letting the feet into the ground, that they may not slide ; fix three cross bars to the legs, at the same height as in the other gin ; fix it to the temporary one, so that you may make use of its pole, to carry on the manœuvre.

In case you have no gin, a roll must be fixed to the temporary one ; this is made with a round piece of timber 7 or 8 inches diameter ; it is fixed four feet from the ground, and passes the legs, one foot on each side ; cut a groove one inch deep round this roller at the points where it unites with the legs ; a groove is also to be cut round the legs at the same points ; take two round pieces of wood

five or six inches long; cut round, or deeply notched, at one end, for the purpose of securing them by lashings to the legs; they then form a bed, for the roll to turn in. Six inches from each end of the roll, drive down a stout iron pin, to which lash a handspike, crossing each other, at right angles; the gin thus equipped, manœuvre as before.

ON THE KNOTS MADE USE OF IN THE ARTILLERY. (pl. 2.)

They call single loop, (*ganse simple*,) that form which a cordage takes when you plait it, and bring one of its ends near the other.

The name of coil is given to a cordage, so plaited as to have one of its ends brought to cross the other.

A single knot, is such a one, as every one knows how to do. It consists in forming a coil, and then in bringing round, the end which had been passed over the other, and entering it into this coil.

FLAT, OR STRAIGHT KNOT, (*Nœud droit.*) (No. 1.)

Form successively, with the same ends, two single knots, one over the other; taking care to bring the two ends which are in the same direction, both above, or both under, the end which passes athwart them. Or make a single loop with cordage, pass the end of another, (or of the same,) in that loop; that is: bring the mentioned end from under above the two ends of the loop, passing athwart them; then, repass that end in the loop under, and bring it over, near the end of the same cordage; then, draw in tight, &c.

This knot is used to fix the ends of a cordage which returns upon itself after having passed round something. To tie a gun, for instance, upon its *porte-corps*, (which is termed, to sling "*brêler*,") to lengthen a cordage, or join them when they break

WEAVER'S KNOT. (No. 2.)

This has no other but the last use of the flat knot; that is: lengthening a cordage, or joining two pieces which have broken; however, it is stronger. To make it: plait one of the ends in the left hand, in the shape of a single coil; introduce the other into it, to a length sufficient to answer your purpose; turn, then, the latter end round the coil, held in the left hand, under, or over, according to the position given to it at first; and bring it to pass athwart, between itself and the two ends which form the coil; draw hard, then, on each side, &c.

GERMAN KNOT. (No. 3.)

Form a coil; turn, then, round one of the ends the one which crosses it, by bringing it athwart itself, and pass it in the coil.

This knot is used every time they want so to fix the end of a cordage, which is intended to be well taught, as not to slip while it works, and so as to slack and disengage itself when its tension ceases.

ARTIFICER'S KNOT, (called also boatman's knot.) (No. 4.)

It is used to fix the stays upon the gin, and to stop the end of a cordage, whose other end is already fixed. Make the coils close each other, but in a contrary direction; that is, if one of the ends cross under that part of the cordage which is between the coils, bring the other to cross over; place these two coils over each other, so as to have the ends inside; pass then in them the object which you intend to fasten; then pull the ends. In order to make the same knot round a tree or post, whose top is too high, or not accessible (No. 4. do.) turn the end of a cordage round a tree, (for instance,) and bring it back to pass athwart under it self; take it, then, a second time round the tree, and fetch it again to cross under the part which forms the second round, over the other end.

GALLEY KNOT. (No. 5.)

This knot is used to fix levers to a cordage, by means of which, men draw a piece of ordnance, or some other heavy burthen; (what the French term *galère*.) In the place where they wish to place a lever, the cordage is plaited in the shape of a coil (or ring,) so as to bring its free end over; with this free end, a second coil is formed, which enters the first on its upper part; the lever is placed in this second coil, and they pull upon it.

LOOP FOR THE END OF A ROPE. (No. 6.)

This and the following are easily executed after their models, which are found in the plate (No. 2.)

FISHERMAN'S KNOT, (No. 7.)

This knot, which is used to unite two broken cordages, may become a good substitute for the flat and weaver's knots

PROLONGE KNOT. (No. 8.)

To fix the prolonge to the body of the axle-tree of the limber, it is disposed according to the length it must have for the manœuvres ; and this knot is made, whether it passes into two eye-bolts, as indicated in the figure, or in a single ring.

LOOP FOR THE PROLONGE. (No. 9.)

When one of the rings which is employed to establish the prolonge to be used in the different fires, happens to break, this loop must be made as a substitute for it.

SPLICE, (*epissure.*)

By means of a splice, two cordages are joined without knots, that they may pass through a block or pulley,

When they wish to splice two ropes of equal size, it is necessary to untwist them equally, and of a length proportionate to their strength, taking care to engage them so as to extend the strings of the one upon the other, and passing them successively, three times each, (in the part of the rope on which they naturally fall when thus extended,) through the holes which you have opened by means of a marling-spike, (an instrument of hard wood, horn, or iron, sharpened at one of its ends) Finally, the size of every string must be equally reduced, every time it is past ; so that the size of the splice gradually disappears, and its curvity is rendered uniform in its whole length.

OF BATTERIES,

AND THEIR CONSTRUCTIONS.

OF BATTERIES.

A battery consists of one or many pieces of cannon, united to fire against troops, and the objects which cover, or protect them ; and, sometimes, as in the schools for artillery for instance, to offer to view a fair representation of these different operations.

They give, also, the name of battery to the spot occupied, or intended to be occupied, by pieces of cannon for these purposes.

Batteries are divided according to the object in view, either for defence or attack, in *siege, garrison, sea coast and field batteries.* The last, are the uncovered batteries acting jointly with troops on a field of battle ; they are also called moveable batteries. (See before, the artillery field batteries.)

There are, besides, several sorts of these batteries which take their names from the sort of cannon of which they are composed, such as the *gun, howitzer, mortar, and stone mortar batteries.*

They also give, often, to gun batteries, the name of the sort of firing which is executed by that arm, they are termed as follows :

Plein fouet battery, that battery whose cannon shot is direct, and without rebounding.

A ricochet battery, is that which fires a ricochet, that is, whose projectile overruns a part of the space in bouncing.

Batteries may still receive their name from the direction of their firing, relative to the object which they reach. Thus, they call :

Direct battery, that which perpendicularly fires in the flank, or front, or a work, and the front of a body of troops.

Oblique battery, the firing of which is in such a direction as to open an angle of twenty or more degrees with the length of a fortified place, or line of troops.

Reverse battery, that which plays on the rear of a work, or of the front of a body of troops.

Enfilading battery, that whose projectiles sweep the length of some part of a work, or trench, or front of a troop; they say of a battery in such a situation that it batters a troop in flank, when it fires against a body of troops, and that it plays like a wheel, (*en rouage*,) if it be against a work of fortification.

Cross battery, that whose fires cross each other upon the front of a work, or body of troops.

Redan battery, that whose breast work (*epaulment*,) is directed according to many straight lines which form among each other many salient and *rentrant* angles.

Barbet battery, that whose pieces play over the breast work without embrazure, and whose breast work is stopped at the height of the under part of an embrazure, (*genouillère*,) or about 3 feet, (fig. 42, pl. 3.) The pieces mounted upon garrison, or sea coast carriages, fire over the breast work, without embrazure, but this work is five feet high, and covers the men, (fig. 38, 40, pl. 3.) in which case these batteries are no longer called barbet.

The breast work (*or epaulment*) of a battery, is an elevation of ground in the shape of a parapet, which protects the cannon and men against the enemy's fire. It is, also, sometimes called chest (*coffre*,) (see fig. 46 and 47.) The inferior side of a battery is the side of the breast work where the pieces of cannon must be placed; the exterior is the side which faces the enemy.

Embrasures are empty spaces, left in a breast work, or *parapet*, to pass in it a part of the chace of the piece, for firing; these openings are in the form of a prisme, whose basis is a trapeze; the narrowest side is in, and is kept as small as possible, while the exterior is sufficiently wide, to give to the firing all convenient bearing. (Pl. 3, fig. 47, and 33: *les embrasures*, e, e, e.)

The genouillère is that part of the breast work which extends itself from the soil to the lower part of the embrasure. (*g*, fig. 33.)

The merlons are the massy solid spaces of the breast work comprehended between the embrasures.

The semi-merlons are those parts of the breast work comprehended between its extremities, and the first and last embrasures.

The cheeks of an embrasure are the facings either of saucissons, gabions, &c. (*revêtemens*) which support the merlons, or semi-merlons in the interior of the embrasure. Were not these parts revested, the cheeks would be the profile of those merlons or semi-merlons, measured in the interior of the embrasure.

The directing line of an embrasure, is considered as drawn from the middle of its interior opening to the object they purpose to fire at. The embrasure is direct, when its directing line is perpendicular to the interior side of the battery, otherwise the embrasure is oblique. (fig. 33, and 47. *d. d.*)

The facing, or revêtement, is the interior side of the breast work; let it be made of sancissons, gabions, sod, or plank, &c. to support the earth; they also term it *chemise;* I would say coat, or rather casing.

The plat-form, is a sort of a floor established in a solid manner to bear the pieces of cannon in their several positions, when the firings are executed. They are made with sleepers and planks, for siege pieces; for the new sea coast carriage: they use simply ends of planks, which are arched for the purpose; joices and gites are used for garrison carriages; and for mortars, they only use sleepers, or bottom joists. (fig. 47. *p s*, *p c*, *p p*. *p m.*)

The hurter, which is one of the parts of the plat-form for the pieces, when they are mounted upon field or siege carriages, is a piece of timber 8 feet long, and 8 inches square, which is laid on the soil of the platform perpendicularly with the directing line of the embrasure, and joining, on one side at least, close to the breast work. It serves, when the piece is in battery, to stop the wheels of the carriage, (in order that they do not bear against the facing of the battery, which they would damage) and to place the piece in the direction of the line of its embrasure. (See *a b*, fig. 33 and 47, plat-form, *p i.*)

DIMENSIONS OF BATTERIES.

The breast work of a battery has more or less thickness, according as its object requires, (see field fortification; thickness of the parapet, vol. iii.) they give it as much as 18 feet in its upper part, for siege batteries.

The following dimensions are observed: (pl. 3. fig. 45. which is the profilé made after the fig. 47.)

		ft.	in.
a. b.	superior breadth of the ditch, (they give it 21 or 16 feet,) (*see the note further,*) -	21	0
e. o.	inferior breadth, (they give it 9 or 7 feet, -	9	0
b. c.	depth of the ditch, - - - - -	8	0
b. i.	breadth of the berme, - - - -	3	0

		ft.	in.
i. g. thickness of the breast work, (26 or 21,) (*see the note,*) - - - - -		26	0
d. m. thickness in its upper part, (18 or 15) (*see the same, &c.*) - - - - -		18	0
h. m. height of the interior crest, - - -		7	6
d. p. height of the exterior crest, - - -		7	0
g. h. interior slope, (1-3 or 2-3 of the height; according as the soil has acquired more or less tenacity,) - - - - -		2	0
i. p. exterior slope, (according to the tenacity of the soil,) (*see note hereafter,*) - - -		5	6
k. o. height of the genouillere, (from under the embrazure to the ground,) and it must be observed: that there are two inches less when the plat form planks are laid,	for siege pieces,	3	10
	for field pieces,	2	8
l. r. length of the half merlon, measured at the end,		9	0
g. t. distance between the directing lines of the embrazures,* - - - - -		18	0
o. s. breadth of embrazures measured inwardly,	for siege pieces,	1	8
	for howitzers,	2	8
	for field pieces,	1	3
a. b breadth of the same, outwardly, - -		10	0
Slope of the embrazure towards the country, (for howitzer in a contrary direction)—see fig. 46,		1	0

The necessary breadth in rear of the breast work, is for the platform and recoil of the piece, from 12 to 21 feet according as they use field pieces, garrison, or siege carriages. They even give 24 feet for the last, in order to have more facility for the service round the piece.

N. B.—26 and 18 feet, then, is the thickness of the breast-work in light soils, which gives to the outward slope, at least, the 3-4 of the height; this is in the supposition that the earth is beaten, (which is done pretty imperfectly under the enemy's fire,) for in a contrary case it would be necessary to give as much as one and a half height, to prevent the tumbling of the slope at every shot that it will receive. In a tenacious soil, 15 feet thickness will

* They genarally give 18 feet of length to every piece for the breast work; but this is sometimes reduced to 15; in the field entrenchments, the same distance is sometimes reduced to 12 feet.

suffice for the upper part of the epaulment; this reduces the thickness at bottom to 21 feet. The base of the exterior slope is half the height of the epaulment. The breadth of the ditch at top will be reduced to 16 feet, and at bottom to 7 feet; (fig. 49.) its slope is about half the depth; but in loose earth, it must be at least three fourths; the slope of the counterscarp may be a little less, because it has not an epaulment to support.

In calculating the dimensions to be given to the ditch, in order to furnish earth for the epaulment, the embrasures must be taken into view, each of which leaves a space of at least as much as 300 feet, together with the thickness of the revetment of saucissons, and the difference between the magnitude of the mass of earth before, and after excavation; for earth dug from a ditch will complete an epaulment, whose cubic contents are one sixth more than that of the ditch itself.

The ditch must be made so deep that the workmen may be sheltered in it as soon as they have dug to its bottom, for the battery is constructed under the enemy's fire; and, besides, the ditch must not be too wide, for a man cannot throw earth more than about 16 feet. (In the first of the above mentioned cases the breadth is about equal to this, reckoning to the perpendicular erected upon the outer edge of the bottom of the ditch; the earth that remains on the outside of this may be thrown upon the counterscarp.) If the ditch be wider, the earth must pass from one spade to another, which requires more workmen, and lengthens the labour.

A man may dig and throw up from 50 to 60 cubic feet of earth in eight hours, so that 12 men detached from the infantry, assisted by 6 matrosses, will, during a single night, raise the half of an epaulment, whose dimensions amounts to between 1,800 and 2,300 cubic feet, according to its thickness.

PREPARATION OF SAUCISSONS.

The saucissons that are used for forming batteries, are cylindrical bundles of straight limbs of trees, not more than 6 inches in circumference at the larger end, and tied together at distances of 9 inches, with strong withes : these bundles are a foot in diameter, or 3 feet in circumference, (fig. 32.) and at least 19 feet in length, so that 18 feet may remain when one end is sawn off square, and the other intertwined with the next saucisson.

Saucissons are made out of fascines, cut in the woods that are nearest to the besieged place, by the infantry soldiers, and the inhabitants of the country ; they are then carried to a depot established beyond the range of the artillery of the place, in which the matrosses make them up into saucissons.

A common *fascine*, such as the infantry of the army is taught to make, is a faggot of straight branches, without leaves, but preserving all the little twigs, that are from 4 to 6 inches in circumference at the large end, which is cut slanting. It ought to be 12 feet long, and at least 8 inches in diameter. (2 feet in circumference.) 6, or at most 8, of these fascines, are sufficient to make a saucisson. If the fascine were only 6 feet long, as is sometimes the case, it would take twice the number.

The withes with which the saucissons are tied, are made of young oaks, nutwood, willow, &c. cut for the purpose, and of a suitable size.

Four men are employed to construct a saucisson ; they are provided with 2 bill-hooks, 2 handspikes, a bit of match to measure the circumference of the saucisson, and a rope 6 feet in length, with a loop at each end, to pass the handspikes through, and press the saucisson tight ; 8 stakes, 5 feet long and 3 inches in diameter at the head, to make the wooden horses, a mallet to drive the stakes, a strong knife to trim the fascines ; eight hours is required to complete a saucisson.

The men are divided into gangs of 4, each of which is provided with the above articles. They arrange their horses in a straight line, 16 feet in length, placing, at each of its extremities, two stakes in the form of a St. Andrews cross, one leaning against the other, and crossing about a foot from the ground ; (fig. 32.) at which height

they are tied, in order to facilitate the manœuvre of the handspikes. The fork formed by the stakes, ought to be an angle of from 90 to 100 degrees, and its apex filled up by the rope with which they are tied together, so that the saucisson may be made round. Two other horses are made in the same manner, and placed at equal distances between the two first, in such a way that the spaces between the heads of the stakes may be as equal, and as nearly in the same straight line as possible, and the forks on which the saucisson rests, in one horizontal line.

The horses being placed, two of the four men prepare the wood by cutting the large end of the branches in a slanting direction, straightening those that are crooked by making notches in them with the bill hook, taking care not to cut them entirely through, unless it be impossible to make them answer; the other two receive the wood from them, and place it upon the horses, the ends projecting a foot and a half beyond the two outer ones, so as to make the saucisson 19 feet long; they are arranged as uniformly as possible, and with the ends in one vertical plane; in those places where the pieces have gaps in consequence of their being unequally furnished with lateral twigs, small branches are inserted, and care is taken to put the largest and strongest boughs in the middle of the saucisson, and to make it of the same consistence in every part. The whole is smoothed, by pressing the twigs that project from the surface into the interior.

When the saucisson is furnished with a sufficient quantity of wood, it is tied twice at each end and in the middle, to keep it firm until the withes are put round it, which is begun at one of the ends.

The withes to tie saucissons, must be well twisted, and have a loop at the small end formed by a double German knot. A stick, nine inches in length, must be provided to measure the distance between the withes, and a bit of rope 3 feet in length to measure the circumference, that ought to be every where the same. The four men now unite, two of them take the 6 foot rope and pass it under the saucisson near one of its ends, beside the place where the first withe is to be tied, then wrap it round by passing the loops upon its extremities from one to the other; this done, each takes a handspike and passes it through the loop nearest to him, they draw the rope tight by bearing with equal force on the handspikes

whose ends cross beneath, taking care not to twist the saucisson, (*c*, fig. 32.)

They continue to tighten the rope, until the circumference is brought down to a little less than it ought to be when finished, for the withe will not hold as tight as the cord. Care must be taken to keep the saucisson of a cylindrical figure, by pressing down the branches, and ends that project, in proportion as the rope is drawn tight. One of the other two men places the withe close to the rope, passes its end into the loop, and draws it tight with his foot or a bit of wood, he then fastens it by tying a knot upon the loop, and pressing the excess of the withe into the body of the saucisson; when this is done, the men who are at the handspikes gradually loosen the rope, so as not to break the withe, then change handspikes, and move on to another part of the saucisson where a withe is to be placed, without drawing them out of the loops upon the rope. They thus, place 2 or 3 withes at each end alternately, and finish at the middle. Care must be taken to place the knots of the withes in the same straight line, on some one side of the saucisson.

When the saucisson is finished, it is dressed by trimming off, with a bill hook, all the twigs that project from it; the lumps, if there are any, are flattened by laying it upon level ground, and striking it gently with a mallet. It is then carried to the depot.

Fascines are made with much less care, and are not tied with more than 3 or 4 withes. (*Instruction sur le service de l'Artillerie Francaise*, by Major Hulot.)

OF GABIONS.

Gabions are cylindrical baskets without bottoms, that, when filled with earth, serve to form the revetment of parapets, epaulments, embrasures, &c.; those used for this purpose by the artillery are three feet high, and 18 inches in diameter. (fig. 41.) There are others which are from 2 to 4 feet in diameter, and from 4 to 6 feet high, for the parapets of the trenches of the besieger, and for erecting traverses and paradoses.

To construct a Gabion. Trace a circle (*c*) upon a piece of level ground, with a cord, of a radius equal to that which the gabion is

to have, (say 9 inches,) place in its circumference 9, or only 7 stakes, $3\frac{1}{2}$ feet long, at equal distances from each other ; they must be set perfectly upright, with their ends six inches in the ground, and their heads cut square off, as nearly as possible at the same height.

Take long and straight branches of trees from an inch to an inch and a quarter in diameter at the large end, free from leaves, but still retaining their lateral twigs. If you are compelled to use crooked branches, they must be straightened as much as possible. Twist these branches round the upright stakes, beginning at their large end, which is placed within one of the stakes, and passing the branch alternately on the outside of one stake, and the inside of the next ; when the branch becomes too thin, or it is near its end, another is twisted to it ; and this species of basket work is continued to the top of the stakes, which forms the top of the gabion; the wicker is closed together, from time to time, by striking it with a mallet or the back of a bill hook. When the basket work has been carried to the top of the pickets, it is fastened by three ties, each of which passes round three courses of the wattling, and is made fast to the top of a stake, at 3 points of the circle equidistant from each other ; the gabion is then drawn from the ground, and the lower end fastened in the same way, the points are resharpened if they have been made dull by being driven.

During the construction, the stakes must be frequently examined to see if they retain their proper positions, this is facilitated by a directing stake placed in the centre of the circle.

The wood must be green and flexible ; oak, hazle, and hiccory, are the best.

A gang of three men will make a gabion in two hours ; one constructs the gabion, another assists him, and the third prepares the materials. Their tools are 2 bill hooks, 1 mallet, 1 saw, 1 cord, and 1 mason's level, if to be had.

The *Stuffed*, or rolling *Gabion*, is so called because it is stuffed with fascines ; the first sapper covers himself with it, and rolls it before him as fast as he advances. It is constructed in the same way, but is 4 feet in diameter, and the wattling is 6 feet high ; the points of the stakes are sawn off.

Sap Faggots are $2\frac{1}{2}$ feet long, and 8 inches in diameter; they have a stake within them 3 feet long, pointed at one end, and formed into a handle at the other. They are used to fill up the joints of the gabions of trenches.

Baskets for carrying earth. When the earth necessary for the construction of a battery must be sought at a distance, baskets are employed; they are usually a foot high, a foot in diameter at the bottom, and 15 inches at top.

HURDLE WORK, (figs. 37, 38.)

A hurdle is a web of branches, 6 feet in length, interlaced upon 7 or 9 straight stakes, planted in the earth to the depth of six inches, in a straight line. The stakes are placed at equal distances from each other; the hurdle is from 3 to 5 feet wide, according to the purpose for which it is intended, whether for the epaulment of barbet, siege, or fortress batteries, or for musketry.

The mode of making hurdles is the same as that used for gabions; but as the pieces that are employed are thicker, a bit of wood is tied to the end of a rope strong enough to take hold of the branches, and twist them as with a winch round the last stake, when they are turned back; the work is continued in this way to the top of the stakes, where the three last courses are tied with withes, as in gabions. The hurdle is then drawn out of the ground and laid aside for use.

Hurdle work is sometimes a continuous casing, made at once, and upon the spot where it is to be used, it is then raised at the same time with the mass of earth it is to support. In this case the stakes are driven into the ground with the proper inclination to produce the requisite slope, and are then entwined with the branches. This revetment is supported by strong posts, 4 inches in thickness, driven in at distances of 6 feet; if the earth is very loose, two stakes, two inches in diameter, are placed between each post, to prevent the hurdle work from bending.

When hurdle work is made of prepared hurdles, posts are also placed to support it, in such a way as to cover the places when the hurdles meet each other.

OF SODDED REVETMENTS, (figs. 39, 40.)

The sods that are used in revetments are usually 14 inches wide, and a little less in rear, 9 inches deep, 4 inches thick in front, and a little less behind, after they are placed; this requires them to be 5 inches thick when they are cut.

Sods, to be good, must be cut in meadows where the grass is thick; it must be mown close before they are taken.

In order to face a revetment with them, they must be laid in horizontal courses, the grass lowermost, inclining them a little from the face inwards, and giving their outer line the slope previously determined upon. When a course is laid, the earth is well rammed behind it to consolidate the epaulment, and smoothed by paring off the higher parts with a dutch hoe. Every two or three courses, the sods are cut to the exact slope. It is necessary to pay attention that the joints of one course are covered by the sods of that which is next above it; one sod is laid in cross-ways, and the two next long-ways, and so alternately, in order that they may bind; small pickets are also driven in, that must pass through at least two sods.

There are at least 40 sods in a space of ground 6 feet square. A gang of three men can cut 100 sods in an hour: one raises them up, another cuts them square, and the third slopes them. A wooden model of the surface is sometimes given to the last, but experienced sod cutters have no need of it.

To face a parapet 4 feet 3 inches high, 80 sods are wanted for every 6 running feet, and 100 for a parapet 5 feet 4 inches high.

In order to resist the pressure of the earth more effectually, the sods are sometimes laid in courses perpendicular to the revetment; they are then cut without any slope.

SAND-BAGS.

A sand bag is made of coarse bagging, filled with earth, and tied up with twine. In this state it is from 18 to 20 inches long, and 8 or 9 in diameter. (Fig. 35.) In order to make a revetment of them, they are laid in horizontal courses, and with intervals.

SIEGE BATTERIES.

The batteries that are constructed before a fortress, in order to reduce it, are called *Siege Batteries;* they have an epaulment, with a ditch in its front; the epaulment is faced within, and on the sides, with saucissons, gabions, or hurdles, that support the earth it is composed of. This revetment is most commonly of saucissons, as is shown in fig. 33, and profile, fig. 34; or of gabions, like the barbet battery, fig. 42; or of the two combined, say as high as the sill of the embrasures of saucissons, and the rest of gabions. Sand bags are used when the battery is erected of sand. Revetments are also made of plank and trunks of trees.

The Men and Articles necessary for the construction of a battery of cannon, are:

For . .	Number of Pieces.					
	1	2	3	4	5	6
Matrosses, *not including sergeants,* . .	11	19	27	35	43	51
Workmen of the line, *auxiliaries,* .	12	24	36	48	60	72
Pioneers' tools, (*spades, shovels, pickaxes,*) in all,*	23	43	63	83	103	123
Saucissons, 1 *foot in diameter, and from* 18 *to* 19 *feet long,*†	27	40	53	66	79	92
Stakes, 30 *inches long, and* 2 *inches thick at the head,*‡	270	400	530	550	790	920
Mallets, *to drive the stakes,* . .	4	7	10	12	10	19
Paviers Rammers, *to consolidate the ground,*	3	6	9	12	15	18
Large saws, ...	1	1	2	2	3	3
Axes and bill hooks, (of each,) .	2	3	4	5	6	7
Large rulers and masons' levels, (of each,)	1	2	3	4	5	6
Bundles of match, and rope *to tye saucissons,* (of each,) . . .	2	2	3	3	4	4
Handspikes, ...	4	4	8	8	12	12
Bundles of withes, . . .	2	2	3	3	4	4
Knockers, or *Heurtoirs,* . .	1	2	3	3	5	6
Sleepers, 15 *feet long, and* 5 *inches square,*§	3	6	9	12	15	18
Planks, 12 *feet long,* 12 *inches wide, and* 2 *inches thick,*	15	30	45	60	75	90
Platform pickets, 3 *feet long and* 3 *inches thick,*	10	20	30	40	50	60
Lamps and pounds of candles, (*for the works that are performed in the night,*) of each,	1	1	1	2	2	2

Note. When the earth must be carried in baskets, 5 are required to each piece; they are a foot high, and 12 or 15 inches in diameter.

POSITION AND TRACE OF BATTERIES.

Under the head of the Attack of Places, (vol. 2.) we shall speak of the location of the batteries intended to silence the fires of the place, and then to make a breach in its walls; it is therefore sufficient at present to know, that the best position for a battery intended to enfilade the face of a work, is upon a line perpendicular to its prolongation, and that a knowledge of this prolongation is always necessary. (The line that is known by the name of the Prolongation, is the exterior face of the parapet produced.)

To take the prolongation of the face of the work. Study at a distance the disposition of the works whose prolongation is to be taken, from some advantageous height, (such as a tree, steeple, or hill,) with the assistance of a plan of the front to be attacked. This will aid in reconnoitring them more narrowly. Approach the place so close as to see it distinctly; march along in front of the nearest face, until you find yourself upon the prolongation of the next, then mark this prolongation with 4 or 5 pickets, driven six inches into the ground; their heads must be marked with an equal number of notches, in order that the pickets of one prolongation may not be confounded with those of another. If there are sentry-boxes on the flanked and shoulder angles, or trees planted upon the ramparts, they will be a great assistance. Choose a time

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* The quality of the ground will show the proportion of different sorts of tools that are needed: in ordinary ground, one third of each sort is a good proportion, and some stone picks are mixed with the pickaxes; a spare tool to each piece ought to be added to the above allowance.

† The same number of saucissons will not be needed if the cheeks and sides of the batteries are faced with gabions.

‡ Ten stakes are carried for each saucisson, the number may be reduced to 7 if they are of good wood, and if the earth has not much tendency to fall.

§ When the earth is miry, there must be five sleepers to each platform, instead of three.

of the day when one of the faces that forms the flanked angle is enlightened by the sun, and the other is in shade; if this assistance be wanting, if the fortification be low, if the revetment is only half the height of the rampart, it becomes necessary to approach the place as near as possible, in order to see clearly; if there is any doubt, it is better to be within the prolongation than without it.

The prolongation being thus marked, a point is determined, *a*, (pl. 3. fig. 44.) which marks the distance from the battery to the flanked angle of the work to be battered;* at this point, if the battery is to enfilade the rampart of the prolonged face with the ricochet, a perpendicular, *a m*, is erected in the direction of the inside of the work; this will be the interior line of the battery; at 15 feet from this point *a*, take another, *o*, which will be that on which one flank of the battery must rest; determine the length of the inner side, *o b*, in relation to the number of pieces; raise perpendiculars at its extremities towards the place; mark with stakes upon these perpendiculars, the thickness of the epaulment at bottom, the projection of the two crests, the width of the berm and of the ditch; the directrix of each embrasure must then be marked, and preserved by producing it back within the epaulment.

But if the battery is to destroy the revetment, or the parapet of the face, *c s*, on whose prolongation it is situated; or if local circumstances prevent its being established within the prolongation, and compel the fire to be made a direct one in consequence; then the perpendicular, *a e*, is erected on the outside of the prolongation, and a distance, *a e*, is taken upon this line, equal to the distance between the former position of the battery and the work; from the point, *e*, a perpendicular, *e n*, is erected; this will be parallel to the face that is to be battered, and it will cut the prolongation of the other face at the point *d*, beyond which the battery *g* ought to be established. It is to be observed, that in order to destroy a battery with embrasures, it is much better to fire obliquely than perpendicularly.

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* For the method of finding the distance between the battery and the flanked angle, which is necessary for the purpose of regulating the fire, see vol. 2d, p. 143.

The draught is begun with the inner side of the battery; because, on its position, much of the correctness of aim depends, and because by tracing it first, the ground on which the pieces are to stand may be picked, and it ought to be the firmest and most level that can be found, in order to diminish the labour.

The point where the epaulment of the battery is to commence, is fixed at the distance of 15 feet from the prolongation; because the first piece ought to be placed at 9 feet from this point, in which case its fire will be parallel to the inner crest of the parapet of the face to be battered, and a distance of about 6 feet from it.

The inner line of the epaulment being once determined in position and length, the figure and construction of perpendicular, oblique, and reverse batteries, is exactly the same as of a battery of enfilade: if there is any difference in the detail, we shall mention it.

If it has not been possible to place the battery in such a way as to be sheltered from the enfilading fire of some of the works of the place, make instantly at its extremity, a traverse or epaulment to guard against it, 18 feet in thickness at bottom, and 24 feet in length. (On the ramparts of a place, the traverses are no more than 12 or 14 feet thick, because they have only ricochet fires to guard against.)

The traverses are faced on the inside in the same way as a battery, and also on the two sides, (as shown in the profile, fig. 36.) When they are between two pieces, the traverse ought to be built at the same time with the battery, and therefore the officer ought to have foreseen the necessity of sheltering himself by epaulments, from enfilading fires, when he reconnoitred the position; and ought, in consequence, to have made requisitions for a greater number of workmen and tools than in ordinary cases.

CONSTRUCTION OF A BATTERY.

The captain or eldest officer is charged with tracing and constructing a battery.

As it is often begun at night, and without the knowledge of the enemy, he must provide himself with a dark lanthorn, to see what is done without being himself seen. It is also useful to have some instrument that is fitted for tracing perpendiculars on the ground, with ease and certainty: a square of ropes is convenient for this purpose.

A battery ought to be constructed in 36 hours.

1st Night. The position of the battery being determined upon, it is reconnoitred; the materials and all articles necessary for its construction being prepared, the detachment is assembled and furnished with pioneers' tools, saucissons, and other articles; it is then conducted in silence and good order, at nightfall, to the parallel nearest to this position, where it remains until the commanding officer gives the order to advance.

A party of officers, with some artillerists, carrying cords to trace by, 2 spades, 2 shovels, &c. proceed to reconnoitre the ground, if the draught has been made by day; if not, they lay out the battery immediately. The cords are laid along the stakes, and small ditches dug to direct the work as it goes on; it is a good plan to lay saucissons along the edge of the ditches and the inside of the epaulment, to point out these lines to the workmen more clearly until the work is fairly under way. The battery being laid out, the rest of the detachment, that has been divided into as many squads as there are pieces to be mounted in the battery, advances, and is disposed in the following order.

The 12 auxiliary workmen, to each piece, are placed in couples on the ground the ditch is to occupy, near the berm and parallel to it, with the space of 3 feet between each pair. In this way two men have a rectangle, whose breadth is 3 feet, and length equal to the breadth of the ditch, to excavate; one breaks the earth with a pickaxe the other throws it upon the berm. (If the earth is of such a nature that it can be lifted with the spade without using the pickaxe, the labourers may be placed nearer each other, and will hasten to throw earth on the place of the

epaulment, and afterwards 3 of the 12 will place themselves upon the berm to throw the earth still higher.) When the workmen in the ditch have arrived at such a depth as to be well covered from the fire of the place, and when the epaulment is at least two feet high, then 6 of the workmen leave the ditch, 3 of whom place themselves upon the epaulment, and 3 upon the berm at 6 feet from each other to arrange the earth as it is thrown up.

Five matrosses, to each piece, work upon the revetment; 3 at each embrasure, and three at the extremities of the epaulment; but until it is time to commence these revetments, which is not done until the earth is at least 2 feet high over the whole epaulment, the five first are employed in smoothing and settling the earth in rear of the epaulment, in ramming the parts that are filled up, particularly on the site of the platforms, and removing the ground where it is too high.

Three others place themselves upon the berm at the distance of 6 feet from each other, in order to throw the earth, taken out of the ditch, towards the inside of the epaulment, 3 others placed on the epaulment spread and ram the earth. As soon as the labourers of the ditch mount upon the berm, the matrosses who were posted there, retire to work on the revetment.*

The important point to be attained the first night, is to raise the epaulment as much as possible before day break, so as to be covered by that time from the fire of the place, and be able to work with less danger on the following day.

If the battery is not in the parallel, trenches of communication must be established to it. One of the officers will attend, to have them constructed at the same time with the battery itself, by additional workmen detailed for that purpose. These communications ought to be 12 feet wide, and should have a parapet like the rest of the trenches; they must be finished the first night. If the workmen are too much exposed to the enemy's fire, a row of gabions is placed on the outer edge of the ditch and filled with earth; some

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* It is evident, that during the night and under the fire of the place, this order cannot be rigorously observed; but it must be attempted, that the confusion may not be increased, nor the doubt and delays, that numberless inevitable accidents will throw in the way of the work, multiplied.

is also thrown behind them. (See fig. 47, gabionade *g g*, and its profile *g*, fig. 45.) Then, in order to diminish the danger of those who form the parapet, a row of gabions, filled with earth, is placed on the inner edge of the ditch, and another over it if necessary, leaving gaps through which the labourers in the ditch may throw the earth; or else the ditch is prolonged beyond the ends of the battery for that purpose; the uppermost row of gabions is then thrown down into the body of the epaulment.

Finally, if the fire is so violent, that the battery cannot be made from without; the trench is made use of, and its parapet thickened with earth taken from within.

The workmen of the line are relieved every twelve hours, and the matrosses every 24, but neither the one nor the other are permitted to depart, until those who relieve them arrive.

Two hours before the workmen or matrosses are relieved, say two hours before day break, and two before dusk, an officer will go from the battery to the depot to receive the relief, and will cause them to take saucissons and other articles, in conformity to the orders he has received, on that head, from the commander of the battery. He will also make a requisition for extra labourers if wanted, to be detailed either for that particular time, or some other he will point out.

First Day. The labourers of the day will continue to increase the thickness of the epaulment, in the same way as their predecessors; if they are too much exposed, they will confine themselves to throwing earth upon the epaulment, and those who cannot do this from within the ditch, will look for it in the interior of the battery in places sheltered from the fire of the enemy; or will go to bring wood for the platforms.

The interior revetment is begun at day-break: for this purpose, a little trench, (fig. 33.) 8 inches wide, and 2 inches deep, is dug within the inner line of the battery.* This trench is levelled along its whole length, using for that purpose a long ruler, and a mason's level.

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* If the saucissons are less than a foot in diameter, as sometimes happens, say for instance, 10 inches, it would require 5 of them instead of 4 to reach the sill of the embrasure, which ought to be 3 feet 8 inches above the platform, or 3 feet 10 inches above the ground, the trench must, in this case, be made four inches deep.

If a rapid slope along the front of the battery, compels breaks to be made in the lower fire of its revetment, the part in front of each gun at least is laid level. A saucisson is then placed in the little trench, the knots of the withes turned in towards the epaulment; it is fixed in this situation by small stakes $2\frac{1}{2}$ feet long, 2 inches in diameter at the head, and driven in at every third withe; but as there are several saucissons in the front of a battery of more than one piece, the two last stakes are not driven until the next saucisson has been laid, and its head inserted into that of the other; this is called *larding* it; a withe is tied round the intersection of the two heads. Stakes are driven in like manner into all the saucissons along the epaulment, and into those at its extremities, that are laid at the same time. Care is taken to make the heads of the saucissons upon the sides, and those on the front of the battery, pass alternately in front of each other; in this way, the facing is rendered more solid. (The ends of the saucissons, at each extremity of the face, and side of the battery, may be sawn square off, so as to join better into the ends of those that form the angle, and that the work may be neater; this, however, may be dispensed with in presence of an enemy.) The same three matrosses will finish the revetment of both the sides of the epaulment, placing a saucisson first at one of them, and then at the other; as soon as a saucisson is staked down, and joined to the next, the space behind it is filled with earth, and well rammed to render it solid. (It is more expeditious, and quite as good a plan, to make the ends of the epaulment of gabions; two rows will be high enough.)

A second row of saucissons is placed upon the first, and a third upon the second, and so on to the height of the sill of the embrasures; but as the revetment must have a slope of $\frac{1}{3}$, or at least $\frac{2}{7}$ of its height, each row of saucissons must be placed a little in rear of the other; it is always safer to give the revetment too much, rather than too little slope, to prevent the pressure of the earth from forcing it in. (fig. 34, which is the section of fig. 33.) (*Hulot.*)

In driving the stakes of the third, fourth, and upper rows, they are inclined in such a way as to pass through the two courses next beneath them, but without projecting from the facing.

The joints of the saucissons must not be over the joints of the courses next below; this would weaken the revetment; thus, if the first saucisson of the first course is 18 feet long, the second must be begun with one from 9 to 12 feet long, or one must be sawn

to that length. Care must be taken that the last course, which forms the sill, has no joints in those places where the openings of the embrasures fall; they are, as we have previously said, placed 9 feet from the extremity of the battery, and 18 feet distant from each other.

If the stakes are not good, if the earth is light, and has a powerful pressure; if it is to be feared that the revetment of the battery is not solid, when the *genouilliere* is finished, withes are added to consolidate it. For this purpose, place a good stake opposite the middle of each merlon, passing in the usual way through the saucisson; then pass a very strong withe over the saucisson, and tie it as tight as possible to a stake driven firmly into the ground a few feet within the body of the epaulment, the withe must be perpendicular to the revetment.

When the saucissons are a foot in diameter, and the first placed two inches in the ground, the fourth course will fix the height of the sill of the embrasure, at 44 inches above the platform, and 46 above the ground.

When the revetment has reached this height, the captain marks the centre of the opening of each embrasure by small stakes; he also marks the width of the inner opening of the embrasures, that should be 20 inches for guns, and 32 for howitzers, by placing small pegs, at equal distances, on each side of the central one.

The placing of the saucissons is then continued upwards for the revetment of the merlons, taking care to give them the same slope as those below, and cut them perfectly square at the two ends, in order to preserve the embrasure of the same width from top to bottom. The ends of the saucissons must, when placed, be all in one vertical plane. The height of the merlon is completed by placing a few inches of earth over the last saucisson.

Over each embrasure, is placed the end of a saucisson, 4 or 5 feet long, fixed down by stakes, and bearing on the upper course of saucissons, this strengthens the two merlons, and saves the pointers from musket shot.

Note.—It is better to make the revetments of mortars, above the sill of the embrasures, of gabions; it is both more expeditious to construct, and more easy to repair in the course of a siege. If a cannon shot carries away, or forces out a lower saucisson of the cheek of an embrasure, or of a merlon, the whole must be taken

down in order to repair it; instead of which, if the revetment is of gabions, no other need be removed than that which is damaged; and this is easily done, because the joints are perpendicular. (I had practical proof of the superiority of this method at the first siege of Dantzic.)

During the day, the captain traces the directing lines of the embrasures, (if it has not been done when the battery was laid out,) by planting a stake on the outside of the epaulment, in a direct line between that which marks the centre of the embrasure and the object to be battered. As this line is employed in the construction of the platform, it is prolonged into the interior of the battery, and marked by two or three stout stakes driven down to the level of the ground.

The platforms ought to be begun before the night sets in, and the knocker and sleepers laid; the embrasures must also be begun, which is easy if they are made with gabions.

Second Night. The labourers of the second night ought to bring with them the remainder of the articles necessary both for the revetment and the platform; also 8 gabions in addition, filled with fascines, to each embrasure, to form a mask that may cover the men that work upon the cheeks of the embrasure, who would be otherwise much exposed, if the besieged does his duty.

The labourers having arrived, some throw the earth heaped up on the berm, into the body of the epaulment, others throw up more if it be wanted.

The interior of the battery is levelled; the small magazines built; and the road by which the guns and ammunition are to be brought forward, the same night, constructed.

The matrosses form the cheeks of the embrasures, and construct the platforms.

Cheeks of the Embrasures. When the directrix is perpendicular, set off 5 feet to the right and left of its extremity on the outside of the battery, and having marked these points with stakes, (*a b*, figs. 33. and 47.) they will determine the lines of the cheeks and the side of the embrasure.

But if the directrix be very oblique, the above construction would be liable to the inconvenience of making the embrasure too

narrow, and its cheeks so close to each other as to be easily destroyed by the fire of the cannon. In order to remedy this, a distance must be set off upon the directrix, from the inner opening of the embrasure, equal to 18 feet, diminished by the difference between the spaces, existing between the middle of the knocker and the revetment, in an oblique and in a direct embrasure. At the point that marks this distance, raise perpendiculars 5 feet in length on each side of the directrix, and draw lines through their extremities, and the edges of the inner opening of the embrasure; they will mark the line of the cheeks.

The embrasures being traced, they must be opened in order to construct the revetment of their cheeks; for this purpose the part of the epaulment opposite to the opening of the embrasures, is covered from the fire of the place by, what is called, a mask. In order to construct this mask, place 6 of the 8 gabions brought for the purpose, on end before the mouth of the embrasure, and set the remaining two before the joint of the two outer ones at each end; if they are not full of fascines they must be filled with earth from the embrasure; heap up some of this earth, also, in front of the line of gabions, and throw the remainder to the right and left over the merlons; when the battery is finished, the mask is thrown into the ditch. Instead of a mask of this kind, nothing more is sometimes done than to leave a mass of earth in the middle of the outer opening of the embrasure, cutting a trench in the direction of the cheek, of such a width, that a saucisson or a gabion may be placed in it; but this method embarrasses the construction of the cheeks, the earth is in the way of placing the saucissons, and does not cover the workmen sufficiently from the enemy's fire.

The little trenches having been made to the right and left of the embrasure in the line of its cheeks; lay the lowermost saucisson of each cheek, having cut their ends square off where they terminate against the saucissons of the merlons. Give them a slope in conformity with that the bottom of the embrasure is to have. This ought to be from the inside to the out when the fire is to plunge, and the reverse when it is directed against a lofty object. This slope then varies with the position of the object; it is regulated upon the principle that the mark must be distinctly seen, and the men covered from the enemy's fire, as much as pos-

sible. It follows, that in order to lay the first saucisson of each cheek, the trench must sometimes be made deep enough to bury it for a part of its length. The first saucissons must be firmly staked down, and the earth rammed behind them ;* then place the remaining saucissons of each cheek in such a way that their ends may rest vertically upon each other, at the inner opening of the embrasure, and join exactly to the saucissons of the merlons ; from this place they each retire a little behind the other, until the two upper courses of each cheek are 13 feet apart at the mouth of the embrasure, while the lower courses are not more than 10. The surface of the cheeks ought to be of a regular and well marked obliquity. Fix these saucissons with stakes, in the same way as the others, as soon as they are placed, and ram the earth carefully behind each of them.

A revetment of gabions requires much less time, and costs less trouble ; the first gabion on each side is placed perpendicularly, the tops of the others retire backwards.

CONSTRUCTION OF THE PLATFORMS FOR GUNS.

Smooth, level, and ram the earth of the interior of the battery, in those places the platform is to occupy. If this ground rises or falls by sudden pitches, that cannot be reduced without difficulty to one plane, smooth it partially and in stages ; then form for each platform a uniform surface, of at least 15 feet in length, and 10 in width against the epaulment, by means of earth brought for the purpose, and mixed with fascines, saucissons, &c. ; raise or lower the surface as much as is necessary to make it, when it meets the revetments, just 46 inches lower than the sill of the embrasure.

Position of the Knocker. The *Heurtoir*, or Knocker, *a b*, ought, in all cases, to be perpendicular to the directrix, which ought to bisect it. It ought to be as near the epaulment as possible, and yet permit the piece to be pointed ; for the muzzle must enter fairly into the embrasure, or it will injure the cheeks. The

* In the batteries at the schools of application, a slope of one inch per yard is allowed from the inside towards the front.

knocker is placed near the foot of the revetment, upon ground of such a height that its lower face may be 3 feet 10 inches beneath the sill of the embrasures, lying against the revetment, and touching it along its whole length, when the embrasure is a direct one ; but if it is oblique, as it ought then to touch it only at one end, it is placed in the following manner: double a piece of cord *a e b*, fig. 47. platform *p i*, fix one of its ends to each extremity of one of the lower edges of the knocker, that touches the revetment *a* at one end, and has its centre over the directrix ; retire from the epaulment along the directrix, keeping the end of the knocker against the epaulment and its centre over the directrix, until both ends of the cords are drawn equally tight. Fix the knocker permanently by driving two strong stakes, one at each end, and fill up the space that is left between it and the epaulment when the direction is oblique ; lastly, ram the earth.

Note. If the knocker were not perpendicular to the directrix, the piece whose wheels rest against it could not fire along that line, and in order to point it in that direction, it would be necessary that one wheel should touch the knocker while the other did not, a position that is not solid, is difficult to take by day, and impossible at night. Some artillerists are for placing the knocker, upon the sleepers, that are then brought forward to touch the revetment, in order to secure it more firmly ; but it is to be observed that a shell falling upon the platform would tear up a knocker of this sort, the replacing of which is a delicate operation, and very important. If it be placed according to the above directions, it runs less risk of being deranged.

Position of the Sleepers. Dig a trench 15 or 16 feet long, and 7 or 8 inches wide, along the line of the directrix, beginning at the knocker ; make it 5 inches deep towards the epaulment, so that the upper surface of the sleeper may correspond with the lower face of the knocker ; this trench ought, if the ground is horizontal, to diminish in depth as it proceeds towards the other end, as it ought to have an inclination forwards. (fig. 45.) Make a similar trench to the right and left of this, and distant from it 2 feet 8 inches from centre to centre ; ram the bottom of these trenches till they are firm, particularly if they are in made ground.

Lay the first sleeper in the middle trench, and in the vertical plane that passes through the directrix of the embrasure, in such a way that this plane bisects it along its whole length. This is done by suspending a plumb line in several points of the directrix, and laying the middle of the sleeper directly under it.

Place the end of this sleeper against the knocker, so that the upper surface of the one may be in the same plane as the lower surface of the other, and that the upper surface of the sleeper may not incline to either side. The sleeper must slope from the rear towards the front, at the rate of half an inch to the foot. To effect this, take a bit of wood 7½ inches long, (if the sleeper is 15 feet,) place it upright on the end of the sleeper nearest the epaulment; lay a ruler, on which a mason's level rests, over this and the other extremity of the sleeper, that must then be moved up and down until the plumb line of the level hangs in its groove.*

(If it is a ricochet battery, the sleeper ought to be laid level.) (fig. 46.)

Place the two other sleepers in the two remaining trenches,† giving them an equal inclination, and lay all three in the same plane. Fill the interstices between the sleepers with earth, and ram it in order to fix them firmly, taking care not to derange them while doing it. (When the ground is not firm, another sleeper is laid in each of the spaces between the 3 first, making 5 in all.)

Of Laying the Planks. Lay the planks down, the first resting against the knocker, and its two ends projecting an equal distance on each side of it. They must join as correctly as possible, and one must not project above the other, in consequence of any considerable inequality of thickness; if the irregularity is too great, they are smoothed off with a plane. If they are accidentally of un-

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*In the batteries of the schools of application, where the charge is one quarter of the weight of the ball, and the recoil is consequently less, the slope is only one third of an inch to the foot.

† The distance of 5 feet 4 inches between the two outer sleepers is calculated, so that the wheels of the gun-carriage, whose trench is a little narrower, bear upon these sleepers.

equal lengths, the shortest must be laid next to the epaulment, and the others in the order of their lengths. As the platform ought to be 15 feet wide, it will take 15 planks a foot in width, or 14 of 13 inches, &c.

Fix the last plank by four stout stakes, one at each end, and two in the middle, cut them off to a level with it; lay earth around, and to the level of the planks. (See fig. 47. platform *p s.* and its section, fig. 45 for cannon, and 46 for howitzers.)

Platforms are sometimes made in a more simple, but less substantial manner: a plank is placed lengthways, upon each of the sleepers that lie under the wheels, and two short planks under the trail. (fig. 48. *p. c.*) In some cases, no sleepers are laid under these planks, but bits of joice are laid across beneath them, one at the head, near the knocker, another immediately under the place where the wheels rest when in battery, and one beneath each end of the plank on which the trail rests.

The earth is, finally, levelled around the platform, and that which lies between every two platforms, sloped in such a way as to throw the water into the rear of the battery. When the ground will not permit this, the slope is made to the foot of the epaulment, where cess-pools are made and filled with stones, twigs, &c. into which the water enters, and is absorbed by the earth.

Racks. To the left of each platform, and towards the middle of the interval, between it and the next, place two wooden frames or racks, 9 feet apart, to hold the implements belonging to each piece; (the distance between them is only three feet in the case of mortars and howitzers;) each of these racks is made of two stakes, $2\frac{1}{2}$ feet long, driven about a foot into the ground, and crossing each other at right angles, about 9 inches from the ground; it is fixed in this position, by tying it with match rope.

Powder Magazines. A small powder magazine, *q*, (fig. 47.) is constructed for every three pieces; opposite to a merlon, and about 36 feet distant from the epaulment.* Into this are put two

* If the epaulment of a battery, distant 125 feet from a rampart 26 feet in height, and upon the same level, is 7 1-2 feet high. It will be found, that the

casks of cartridges, to meet the consumption of the pieces; it is made of posts and plank, or of bodies of trees, and is from 6 to 9 feet square; it is sunk completely into the earth, if the ground will permit, and if it will not, is surrounded with gabions and sand bags, and covered by a bomb-proof blind. Make its communications with the battery easy and secure.

To bring the pieces to the battery. "They ought to be brought forward during the second night. The captain ought to reconnoitre the roads, at least from the trenches to the battery; he ought to mend such parts as are muddy, fill up the ditches, or make bridges over them, smooth the declivities, close the craters of shells, open the parallels to permit them to pass, and then close them, or which is better, mask the openings, by erecting a traverse in front of them, in order that the parallel may be passed whenever it is wished, and yet not be exposed to the besiegers fire.

"If there are several batteries, there must be more than one opening, or confusion will be the result.

"If the road is a bad one, and battered too hotly by the fire of the place, drag the cannon forward by hand, at least over the dangerous places; they will then be sooner passed.

"If the platforms are finished, place the guns upon them, if not, shelter them opposite to the merlons.

"If you are compelled to leave a piece exposed to the fire of the place, when the day is about to break, cover it with fascines to hide it from the enemy.

An officer, and sometimes the captain, must go to direct the bringing up of the pieces, particularly if the operation is difficult. The officers ought to be present wherever it becomes necessary, to give directions, to push the work, and encourage the soldiers, by exposing themselves to the same danger they undergo.

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line of fire of the cannon on the rampart, considered as a straight line, from which it will not vary sensibly, will strike the ground only 50 feet in the rear of the epaulment.

OF BREACH BATTERIES.

The epaulment of these batteries is seldom more than 12 feet thick ; for they are usually in the sap of the crown of the covered way, which is often not farther than that distance from the crest of the glacis ; this epaulment is, therefore, no more than a finished sap parapet. If the sap will permit it, the epaulment must be made thicker, provided the foot of the rampart can be seen from the battery, which must be parallel to it.

The battery is constructed from within, taking advantage of the sap, and it may be sunk into it as far as the sill of the embrasures, throwing the earth from within the sap, upon the part of its parapet, that is intended to serve as an epaulment to the battery. The embrasures are direct, but when the epaulment is only 12 feet thick, the outer opening must not be more than 7 feet wide.

The rest of the construction is the same as in other batteries. Pieces of saucisson over the openings, and embrasure shutters, are more particularly wanted in batteries in breach, in order to shelter the pointers from the fire of musketry.

Embrasure shutters, (fig. 51.) are leaves of thick oak wood, fixed by means of hinges, to a frame, that are placed before the embrasure, when the fire of musketry is dangerous ; they are opened to run the piece to battery, and at the time of firing, but shut while it is loaded. They may also be made sliding, by placing two upright posts in the ground, at the extremities of the knocker, that are connected together by two cross pieces, in which grooves are cut, where the two pieces of plank that form the shutters, slide.

REDAN BATTERIES.

It has been seen that an oblique embrasure weakens the epaulment in proportion as its direction is more or less distant from the perpendicular. In order to obviate this fault, redan batteries have been invented, which permit the embrasures to be made direct, and consequently more durable ; each piece enters the embrasure as far as possible, they therefore last longer without re-

pairs. This sort of batteries is also thought good when there is a risk of flanking fires.

These redan batteries are difficult to construct, and require more time than the others; this is a great fault when they are erected under an enemy's fire; they expose a greater surface to his view, either by the number of their angles, or the length of the alternate cheeks, if angles are avoided; besides, the re-entering parts are weak, if the mass of the parapet is not enormous, particularly when the redans are very deep.

It is to be observed, that unless the fire is to be directed upon a single point, (a case that very seldom occurs,) the embrasures will not require to be made oblique enough to need redans, when the first embrasure is direct.

To guard against enfilading fires, a return is made at the extremity of the battery whence it is feared, and traverses of gabions between every two pieces; they require less time and labour than redans, and are probably better.

Local circumstances, however, may require the construction of redan batteries. They differ from the others in no respect, except in the figure of their interior. The redans ought not to overlap more than $4\frac{1}{2}$ feet, and should be thrown back 12 feet. (*Gassendi.*)

HOWITZER BATTERIES.

The dimensions of howitzer batteries are the same as those for guns; the sill of their embrasures may be 4 feet high, but is not usually more than 3 feet 8 inches, like the others. These batteries may be sunk into the earth to the sill of the embrasures, when the nature of the ground will permit, and when the water can be carried off.

The inner opening of the embrasure is 32 inches wide, on account of the shortness of this piece, and the great diameter of its muzzle; the outer opening is 10 feet wide. The bottom of the embrasure has usually a slope inwards, at an angle of 10 degrees, that passes through the exterior crest of the parapet x x, (figs. 46, 47.) The slope is made of this magnitude, because this angle is often used in firing, and because men are covered by it as

much as they can be under any circumstances. If it is necessary to fire at a less elevation, the slope towards the interior must not be so great.

The platforms are without slope, because the charges are small and the elevations considerable. They are in other respects the same as for guns.

A separate magazine is constructed for loading the howitzes; it is built with precautions similar to those taken with the powder magazines.

MORTAR BATTERIES, (pl. 3. fig. 47. *p. m.*)

There are no embrasures in their epaulment; their dimensions are, in other respects, like those of gun batteries, and they are constructed in the same way. These batteries may be sunk 3 or 4 feet into the ground, or even more if it is commanded, provided there is a way for the water to run off; in this case less earth will be needed, and the ditch may be narrower and shallower. The dimensions that are to be changed may be easily estimated. (If the same number of matrosses are employed upon them as upon gun batteries, the work will proceed more rapidly; or they may conveniently be reduced one third.)

An epaulment 15 feet in length is sufficient for a mortar, or even one 12 feet long may answer without inconvenience, but the half merlons at the ends must not be shortened.

Platforms. The platform for short range mortars is made of 12 sleepers, that are called the beams, and are 6 feet long and 8 inches square; for long range mortars there must be 14, 7 feet in length, and 8 inches square. (Pl. 6. fig. 8.)

The construction of platforms is begun by determining the directrix, by means of a plumb line and two rods placed perpendicularly, one upon each crest of the epaulment; it is produced within the battery, and marked by small stakes. Three trenches are then dug, 7 feet long, 10 inches square, and 14 inches below the level that is to be given to the soil of the battery. The middle one is made in the line of the directrix, the other two parallel to it, and at the distance of twenty inches on each side; they

are $7\frac{1}{2}$ feet behind the epaulment.* A sleeper is placed in each trench, the centre one exactly in the line of the directrix; they are levelled, and the intervals filled with earth rammed hard. The others are laid upon these three, and at right angles to them; the first towards the battery and its outer surface, directly over their ends. Care must be taken to lay their ends so that no one projects beyond the rest. They are held in their places by 4 stakes planted at the head, and 4 at the foot of the platform. The earth is raised around them, hard rammed, and regulated in such a way as to leave a drain for the water to run off, as in the other platforms. (The platform will be raised above the surface the whole difference between 14 inches and the thickness of the two courses of beams; this is, in the present case, 2 inches.)

The powder magazines, and those in which the shells are loaded, are the same as in howitzer batteries.

Platforms, for mortars with beds cast on them. "The 12 inch mortar, whose bed is cast upon it, recoils 12 or 14 feet upon a common platform; this renders it difficult to bring them to battery. In order to obviate this inconvenience, platforms have been constructed, the front of which, when the mortar is in battery, is horizontal, and the rear raised in an inclined plane. To establish such a battery there must be,

Five sleepers, 12 feet in length, 6 inches wide, and 8 thick for half their length; at this place, the thickness begins to augment, at the rate of $1\frac{1}{3}$ inches per foot, to the other end, where the thickness is consequently $16\frac{2}{3}$ inches.

Twelve beams, 9 feet in length, and 12 of 8 feet; their breadth is 6 inches, and thickness 8 inches.

Thirty foundation stakes, 15 inches long and 3 inches in diameter.

Twenty-two platform stakes, 3 feet long and 4 inches in diameter.

Five parallel and equidistant trenches are dug 15 inches below the level of the lower side of the sleepers, the centre trench being

* This distance ought to be equal, in general, to the inner height of the epaulment, unless when the mortars are to be fired as ricochets at a very acute angle. In that case, the front of the platform must be 10 feet from the epaulment.

in the line of fire ; six stakes are driven to the head in each trench, 2 feet apart, and well levelled. (If the ground is not firm, holes 18 inches square are dug, at the bottom of each of which a square stone is placed to support the stakes.)

In these trenches, and upon these stakes, the five sleepers are laid, at the distance of 33 inches from centre to centre, the part that is cut into a slope being behind and uppermost. Their surfaces are set in one plane. The trenches are then filled with earth which is well rammed against the sleepers to make them firm.

Upon the sleepers are laid the beams, the first and the other odd numbers are long ones, the even numbers short. The 13th, which will lie at the commencement of the slope must be cut to a bevel so as to lie close against the 12th for its whole length.

A platform stake is driven to the right and left of each of the short beams, and to the level of their surface.

The platform is fixed in its place by 6 stakes behind and 4 in front ; but if the earth is not firm more must be used." (*Gassendi.*)

OBSTACLES THAT MAY BE MET WITH IN THE CONSTRUCTION OF SIEGE BATTERIES.

It may be necessary to establish batteries upon bare rocks ; on stony or marshy ground ; upon places that are made narrow by canals or branches of rivers, &c.

Bare Rocks.

Sacks of wool, bags of cotton, and other similar articles, if they can be procured, may be used to advantage to make a mask that will cover the men ; or else the stuffed gabion that is used in saps, (see *Attack of Places*, vol. 2.) may be employed. Formerly, *Chandeliers*, 7 feet high, were used, between the uprights of which, fascines, from 6 to 9 feet in length, and 6 inches in diameter, were laid. This made what was called a *Mantlet*, (fig. 43.) but it is now replaced by the stuffed gabion.

The earth is carried in baskets, sand bags, &c.

"Begin the revetment with a row of gabions 3 feet in height, and of uniform dimensions ; incline them according to the slope

that is to be given. The lower part of the revetment is not made of saucissons, because the stakes that fasten them could not be driven. Upon these gabions lay the saucisson that forms the sill of the embrasures; it must be held in its place by their points, and fastened by stout stakes. Construct the rest of the battery as usual."

Stony Ground.

"In constructing batteries upon ground of this sort, the stones must be picked out and placed at the bottom of the epaulment; while, for the merlons, earth must be used either entirely free from them, or with as few as possible, in order to avoid their distressing and deadly splinters."

Morasses.

"The first thing to be done is to make a solid road, to bring forward the men, materials, and guns, to the place of the battery. This road ought to be at least 10 feet wide at top.

"Lay one bed of fascines in the direction of the road, another across it, and so on, till it is nearly high enough; over these fascines lay hurdles; and on the hurdles make another bed of fascines about 10 feet in length, laid across the road, so as to render it solid, and better able to resist the shock of carriages; fasten down their ends with stakes passing through the hurdles and the lower courses of fascines; cover them with enough of earth and straw to preserve the fascines, and consolidate the road.

Make the foundation of the epaulment, platforms, and magazines, and consolidate it in the same way; make a berm 3 feet wide upon the front and the sides of the epaulment.

Make masks, and erect the mass of earth in the same way as in batteries upon bare rocks.

If the Position is narrow.

"The parts of a battery where the platforms stand must be 21 feet wide to allow the recoil of guns mounted upon battering carriages; (it may be less if naval gun carriages are employed.)

"If it be but a small part of this width that is wanting, it may

be supplied by filling in either in front or rear of the battery with fascines, saucissons, &c. if the descent is not too sudden, nor to too great a depth; support the epaulment in front by gabions resting upon the foundation made for them. If there be only a few feet wanting for the recoil of the pieces, use for sleepers pieces 30 feet in length, of which 9 feet must be inserted into the epaulment and the other end supported upon trestles. These sleepers must not be less than 7 inches square, and the ground that supports the trestles is made firm by means of fascines or hurdles if necessary. In this case the ends of the sleepers may be even left without support.

If a great part of the breadth necessary for the ground of the platform were wanting, sleepers of the same length, and supported in the same way, might also be employed, but they must be laid the whole length of the battery at distances of two feet from each other. (*Gassendi.*)

Note. We shall treat of the number of batteries, their position and object, under the head of the *Attack of Places*, vol. II. with which they are closely connected.

OF THE BATTERIES OF FORTRESSES.

If the guns are upon battering carriages, the batteries are constructed exactly like those of the besiegers; but if they are upon Gribeauval's garrison carriage, that raises the piece more than five feet from the ground, the batteries are more rapidly constructed, for there are hardly any embrasures to make; they being never more than one foot deep, and even sometimes omitted altogether.

As the rampart is not weakened by the excavation of embrasures, the pieces may be placed only 12 feet from each other: having marked the position of each by a stake, draw a perpendicular from this point to the inner side of the parapet; this will be the directrix of a direct embrasure; the parapet is opened, to the right and left of it, to form the embrasure, 20 inches in breadth within, and 10 feet on the outside, with the inclination necessary to see the object to be battered; the earth is thrown upon the merlons on each side.

The Plane of the bottom of the Embrasure, or *the Genouilliere*, must be 5 feet 2 inches above the terra-plain of the battery, near the epaulment; because the piece is raised 5 feet 5 inches above the platform, and 3 inches must be left for the play of its chace. Then if the level of the platform be 6 feet below the crest of the parapet, the embrasure will be 10 inches deep, and each cheek will be made of a single saucisson.

Platform of the Garrison Carriage.

This platform, (pl. 3. fig. 47. *p p*, and pl. 6. fig. 6.) has no knocker; it has a bolster 5 feet 3 inches long, 3 inches high, and 9 wide, to receive the pintle bolt fixed in the fore transom of the frame; the bolster has dovetails, of the depth and width of 5 inches, cut into each end of it to receive the ends of the two outer sleepers; the third sleeper buts against the middle of the bolster between the two first; (these three sleepers are each 15 feet long and 5 inches square.)

Place the bolster two feet from the epaulment,* and perpendicular to the line of fire, its upper surface 5 feet 2 inches below the sill of the embrasure, and on a level with the terra-plain of the battery, near the epaulment; lay its greatest breadth in the plane of the sleepers; they must be placed parallel to each other, with their upper surfaces in the same plane, and sloping 5 inches from the rear to the front. The two outer sleepers are lodged in the dovetails of the bolster, the centre one only rests against it. Fill up around the sleepers and bolster, and in their intervals, with earth, and ram it well.

No planks are used in this platform; but 3 cross pieces, 5 inches square, are laid, on which the frame of the platform rests; the first of these cross-pieces is $6\frac{1}{2}$ feet long; it is cut into a bow, that projects 2 inches. The second is 7 feet long, the third $8\frac{1}{2}$. These three beams are laid across the sleepers: the first 8 inches from the bolster, measured

* A distance of 3 or 4 inches is sufficient, when the inner slope of the parapet is 2-7ths of the height; but if the revetment is of masonry, this distance must be at least 30 inches.

from the centre; the second, which is to correspond with the first transom of the frame, is, in consequence, 4 feet in rear of the bolster, in the frames of 24 and 18 pounders; (3 feet 4 inches, in those of 12 pounders;) the third beam is a foot from the end of the frame, so as to lie under its rear transom. The three beams are supported at each end, by driving down a stake $3\frac{1}{2}$ feet in length; the first has, besides, 2 driven in front of it, unless there are bolts that pass through the sleepers and the beams.

The intervals of the beams are filled with earth and rammed; some is also put in the rear of the platform, where a piece of plank is laid to serve as a rest to the handspikes when they are used to point the piece. There is no space now left, except between the foremost beam and the epaulment, a space that is necessary for the play of the breast transom of the frame. The earth is smoothed, and waterways formed, as in the other platforms.

Racks for the implements are made in the same way as in siege batteries, and the water is made to run from the front towards the rear of the battery.

HOWITZER AND MORTAR BATTERIES, TRAVERSES.

Howitzer, mortar, and stone mortar batteries, are constructed in the same way as those of the besiegers.

When the batteries of a fortress are too much exposed to the ricochet, traverses are constructed at certain intervals, say between every two or three pieces; these traverses are 12 feet thick, 24 feet long, and a foot or two higher than the parapet; they are faced all round with gabions, as is shown in figure 36. They are sometimes made entirely of gabions, in order to render them more substantial.

Gabions 7 or 8 feet in height, are sometimes used, but those that are no more than 3 or 4 feet high are preferable, because they are more easily repaired.

Where reverse fires are to be feared, paradoses are constructed: these are masses of earth similar to traverses; the best, however, are made of posts or trunks of trees that are inclined like a roof at an angle of 45°, behind that part of the rampart occupied by the battery.

SMALL POWDER MAGAZINES.

Small powder magazines are constructed under the terra-plain of works, to supply the daily consumption of the batteries. There is one on every face of the work. They are made of carpentry, and sunk 6 feet below the surface of the earth. They are usually 8 yards long, 2 wide, and 6 feet high, so as to contain 8 barrels of powder of 200 pounds weight. Two miners and 6 labourers will make one in three days. For their construction, 360 running feet of wood, 6 inches square, is wanted, to make the frames and the revetments of the doorway; and besides, 112 square feet of 2 inch plank.

OF BARBETS IN THE INTERIOR OF WORKS.

During the first period of a siege, and until the fire of the enemy becomes troublesome, barbet batteries are established on the faces and at the flanked angles of the bastions, half moons, &c. to discover the whole of the attack from a distance, and keep off reconnoitring parties. These batteries are raised above the earth of the rampart, so as to fire over the parapet with battering or field gun carriages. The soil of the battery must be 12 feet in length for each piece, and from 12 to 21 in width, in proportion to the caliber of the guns that are used. (fig. 48, and profiles 49. 42.) The rest is similar to the besiegers' batteries.

In many fortresses the earth is raised for this purpose beforehand; but we shall give the mode of construction to be employed in case of need. Having fixed the height of this barbet by making the *genouilliere h a*, (fig. 49.) 3 feet in height, and having drawn through the point *a* a line *a l* parallel to the base *b s* of the profile, (which ought to be between 12 and 21 feet according to the breadth required by the pieces that are used;) set off *d s* the length of the ramp from *d* the foot of the perpendicular *l d;* this is usually 6 or 8 times the height of the barbet.

To trace the plan, mark upon the magistral *m m*, (fig. 48.) the length of the front in proportion to the number of pieces that are to be in battery; (from 12 to 18 feet are allowed to each piece according to their caliber, and the ground that can be spared;)

through the extreme points *m m* of this line raise the perpendiculars *m c*, *m c*, to the same crest, and make *o c* equal to *o l* of the profile: the rectangle *o c*, *c o* will be the position for performing the manœuvres. Then drawing parallels to the straight lines *o c*, *o c*, *c c*, at distances equal to *d f* of the profile, that we shall suppose to be two thirds of the heigth, and we shall have the slopes *x x*. (It is known, that these slopes vary with the nature of the ground.) The length of the ramp *r* ought to be 12 feet.

In order to establish a barbet at the salient angle of a work, (fig. 50;) if we suppose *a c b* to be the inner crest, *c d* the capital, and cut off the angle by a line *e f*, 12 or 15 feet in length, whose position is found by drawing the lines *e l*, *l f*, parallel to the capital *c d* at the distance of half the above length; these lines mark the points *e* and *f* upon the faces of the work. Then if *i g* be the length of the piece including the recoil and the lines *g q*, *g s*, be drawn perpendicular to the faces *a c*, *c b*, the space *g q e f s* will be that which is necessary for the manœuvre of a piece placed upon the capital. If the barbet is to mount three pieces, the parts of the faces *q m*, *s n*, must each be taken equal to the front occupied by a gun, and then the surface of the terraplain of the battery will be *m t n s f e m*, from which surface the angle at *t* must be cut off, and the ramp *r* made like that above.

In field works, the pieces are sometimes placed behind a simple epaulment $2\frac{1}{2}$ or 3 feet high, and 8 feet thick; the natural ground serving as a platform; in order to shelter the matrosses from the fire of the enemy, when they are not employed at the piece, a trench is made on each side of, and parallel to it from 3 to $3\frac{1}{2}$ feet deep, into which they retire after having performed their duty at the piece.

SEA COAST BATTERIES.

These batteries ought to be so placed as to have a full view of the point they are to batter, and yet so that vessels may either not be able, or may find it difficult, to approach and silence them; their fire ought to cross upon the different points, where the enemy can appear or anchor; and they must be advantageously situated as regards their defence on the land side. (*Gassendi* speaks of them in the following manner.)

"They ought to be 50 feet high if vessels cannot come nearer them than 600 feet, and may be raised 75 or 100 feet, without losing the advantages of the ricochet, if they cannot approach to a less distance than 1200 feet; we shall see the advantages of such an elevation.

"Balls ricochet better on the water than on the land, and all ricochets under angles of 2 or 3 degrees do not sensibly diminish the force of heavy balls; 24 pound shot, bounding at an angle of 4 degrees, still preserve more force than is necessary to pierce the side of the largest vessel, at the distance of 2000 feet, or even more; thus every battery that is so low as to be exposed to the ricochet of a vessel, will receive all its spent shot, that will do it much damage; and every battery that is sufficiently raised to fire at a proper range upon a ship under an angle of 4 or 5 degrees, will do it all possible harm, for all the low shot of the battery will strike the vessel, while those that proceed from the vessel, that is lower than the battery, cannot rise high enough to strike it if elevated as much as we have mentioned above. In order to know the height of a battery that will possess this advantage, we must recollect, that the balls ought to touch the water at an angle of 4 or 5 degrees, when distant 600 feet; making this radius the height of the battery will be the tangent of that angle, which is between 40 and 60 feet. If we raise our batteries to this height, the balls will ricochet well to vessels at a distance of 600 feet, if they are not hit by direct shots; while, on the other hand, the fire of the vessels, whose guns are not raised more than 6, 12, or 18 feet, cannot reach in its ricochets to the height of the battery. In this way we shall have every possible advantage over the vessels; since they cannot strike the battery except when they

fire directly at it; an advantage of the very first sort, because it turns to account all the mistakes that are very numerous on such occasions.

"Let us next compare the advantages of our direct shot with theirs: we have the whole body of the vessel for an object, and he can do no damage but by shot passing within a foot and a half of the top of our epaulment, for our guns are not exposed more than that; every other part of the service is covered by the epaulment; thus the vessel, in every 18 feet of epaulment, will have no other mark than the piece, that offers a surface $1\frac{1}{2}$ feet square and no more, while we have 2,700 square feet upon a vessel to aim at, without calculating the sails, ropes, and masts. This second advantage is still greater than the first.

"But there is yet a third, that exceeds either of the others; it is the power of taking aim. The gunner of the vessel, placed behind a screen, does not see his object; when he elevates his piece, he must do it by guess, and having pointed into the air at random, it is at least 100 to 1 that the ball does not pass through the belt of $1\frac{1}{2}$ feet wide that the pieces offer to his view; and if it does pass through it in spite of the motion of the vessel, there will yet be only one twelfth part of these shots that will take effect, because the piece does not occupy a greater proportion of the parapet.

"We may therefore conclude, that the fire of shipping is dangerous only, when from want of skill we expose ourselves to the ricochet of their balls; that it is more than 500 to 1, when the battery is upon an elevation, where the ricochet can be used without being exposed to it in return, and when gun-carriages are employed, that may be fired over an epaulment of at least 5 feet high, that a battery of a few 24 pounders will have a great advantage over the heaviest ship of the line.

"There remains a prejudice to be destroyed; it is, that ships of war, anchored with springs on their cables, are able to destroy forts. In opposition to this may be cited the famous *Risban*, at Dunkirk, that has often troubled the ships of the English, but was never destroyed by them. The towers of the island of *Tathiou* have been in their way for ages, and have not been ruined, any more than the forts of *St. Maloes*, *Bertheaume*, *Camaret*, &c.

"It has been said, that when vessels can approach within musket shot of a fort, the musketry of their tops will plunge into the

batteries, and interrupt the service of them. The first remedy against this is, to raise, in rear of the battery, 2 or 3 field pieces, (12 or even 6 pounders,) to a height as great or even greater than the tops of the ships; these being fired close at hand, with large grape shot, will carry away the netting of the tops, and destroy the men behind them. The second remedy, that will also fulfil several other purposes, as it would prevent any vessel from approaching, is to fire from these guns, firework compositions instead of grape shot; these will carry fire into the masts, ropes and sails, when within reach of a musket shot. The incendiary balls we have heretofore described, may also be employed; these have some weight, and solidity enough to pierce, or at least lodge themselves in the sides of a ship. The howitz and the hollow ball may also be employed to produce fire; fire stone might be poured into them, which would be thrown burning in every direction when the projectile bursts.

Red hot balls and shells must also be employed.

"There is another common prejudice; which is, that there are some vessels, whose sides are so thick that they cannot be penetrated by cannon balls. But it was found by experiments made at Chatham, that an 18 pound ball, fired with 6 pounds of powder, penetrates from 37 to 46 inches into the hardest wood; now there is no ship that has sides as thick as this.

"Batteries must not be constructed of masonry, for behind such an epaulment, a single ball that strikes an embrasure, or the crest of the parapet, will throw a quantity of splinters into the battery, and do more harm than a case of grape shot. Every epaulment ought to be covered with at least 2 feet of fresh and tenacious earth; if this contains stones, it must be passed through a sieve in order to separate them. Batteries must almost always be faced with stone on account of the lightness of the soil, and the scarcity of wood for saucissons upon the coasts, yet the revetment is not raised to more than half the height of the epaulment, say 3 feet, and is only $2\frac{1}{2}$ feet thick. If the body of the epaulment is of stone, the embrasures must be lined with wood, and the upper surface of the epaulment covered with it.

"If the ground between the battery and the water, is a slope of such a nature as to raise the ricochets of the vessel to the battery; it must be cut into horizontal steps.

"*Armament.* These batteries should be armed with pieces of heavy calibers; 36 and 24 pounders, on those points that can be approached by large ships of war; 18, and even 12 pounders, may be used in places accessible only to small vessels. In all the batteries there must be howitzers and mortars; their projectiles are much dreaded by shipping. Shells do more damage than howitzers when they fall into the ships, but their fire is difficult and uncertain." (*Gassendi.*)

EPAULMENT. (fig. 7. pl. 6.)

Their epaulment has no embrasures; its height is 5 feet 4 inches; the inner slope should be diminished as much as the nature of the soil will permit; so that when the piece is in a direction very oblique to the epaulment, the chase may still pass so far over it, that it may be neither torn down nor the saucissons burned. If the sea-coast carriages now in use in France, or others similar to them, that raise the piece to a height of 5 feet 4 inches, cannot be procured, embrasures must be made, but they must be used as seldom as possible, for they diminish the field of fire, that in these batteries ought to be very extensive. We have already said, that the sea-coast is preferable to the garrison carriage for this service, because it is more moveable, and has a greater field of fire.

PLATFORM, (fig. 47. P. C. pl. 3.)

This platform consists of three circular pieces of wood, eight inches wide, 8 inches thick, and $8\frac{1}{2}$ feet long, the segment cut out being 9 inches deep; four pieces of plank, of which two are a foot, and two, 16 inches long; 14 stakes, 3 inches in diameter, and 3 feet long, or more, if the ground is soft; and 12 spikes 5 or 6 inches in length; there is besides, a small frame, *c*, to bear the front of the large one.

If it is difficult to find wood, out of which the circular pieces can be cut, $8\frac{1}{2}$ feet in length, and the depth of the segment 9 inches, the arc may be made of 4 pieces, each 6 feet 4 inches, and the depth of the segments 5 inches; for the additional joint,

there must be, in this case, another bit of plank a foot in length, 2 stakes, and 4 spikes, more than enumerated above.

Wood naturally bowed is best, because, if these pieces were wholly cut into the shape, they would be subject to split, in consequence of the heavy weight they have to bear.

In employing Gribeauval's carriage, 22 feet must be allowed between the pieces, because, if no more than 18 were given as in siege batteries, it would follow, that when the direction of the piece made an angle of 45 degrees with the epaulment, there would be no more space for a passage than 6 or 7 feet, which would be very inconvenient in manœuvring them. With casemate carriages, a less interval is allowed, because they are shorter.

The small frame, *c*, which is intended to support the great one, ought to be placed upon horizontal ground, rammed, and well consolidated; and 5 feet 4 inches* lower than the crest of the epaulment, near the lower saucisson, with only interval enough to plant a stake, to hold it in its place, and prevent it from springing, as it might otherwise do when the piece is run to battery. (Pl. 6. fig. 7.)

This small frame ought to be perfectly horizontal, so that the large one, fixed to it by a pintle bolt, may not be impeded in its circular movement, and may not meet with much friction.

The position of the circular pieces of wood is next determined, by tracing, by means of a cord and stake, an arc of a circle, that has for its radius the distance from the middle of the socket of the pintle bolt, to the middle of the convex surface of the trucks of the great frame. The centre of the circle is on the ground, directly beneath the socket cut in the smaller frame, to receive the pintle bolt.

The arc of the circle being traced, a trench is made exactly equal in width and depth to the circular pieces, and so that the arc passes through its middle. They are placed in this trench, the upper part on a level with the lower face of the small frame;

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* This height is determined by that of the muzzle of the piece placed horizontally upon its carriage. Where the great frame has a bolster 15 inches behind its fore transom, to receive the pintle bolt, the small frame is then placed beneath it. This mode of placing them gives a greater scope to the lateral fire.

the two pieces of plank, a foot in length, are placed beneath the joints of the circular pieces, to which they are fastened, when laid down, with two bolts; they are held firm by two pickets. Each end of the circular arc will also bear upon one of the bits of plank, 16 inches in length, to which it is nailed, and is held firm by two stakes placed in front of the cross they form, and one at the extremity. The ground is afterwards levelled and rammed; for pieces larger than 24 pounders, the arc must incline a little towards the battery.

In a battery where it may be necessary to defend the gorge with cannon, the pieces mounted in it may be made to answer this purpose either wholly or in part. In this case, the frame must be placed in a position opposite to that above described, the truck wheels towards the epaulment, and the pintle bolt to the rear; in this way, the carriage will revolve round the pintle bolts, and fire upon every point of the circumference.

The frame is moved in the usual way; or else by a rope fastened at one end to the truck wheel transom, and a lever 9 or 10 feet long, passing through a loop at its other end, and resting on successive points of the epaulment, as a fulcrum.

AIR FURNACES FOR HEATING BALLS.

The furnaces, (fig. 26.) are composed of a fire place, and furnace bars, *f*, where the fuel is laid, and a grate, *g*, to receive the balls to be heated, by the action and reaction of the flame. It takes about 36 minutes, to bring a 36 pound ball to a red heat, with split dry wood. In order to do it as quickly as possible, the fire must be regularly fed, by throwing upon it every 4 or 5 minutes, equal quantities of wood, and turning it with the fork, if it cakes.

It requires 16 or 18 cubic feet of wood, to make the first balls put into a furnace red hot.

If charcoal is the fuel, it takes 6 cwt. to give the proper degree of heat, and 12 pounds per hour to keep it up.

Figure 29 is the plan along the line *i k l*.

Figure 27 is the elevation upon the line *c d*, (the breadth of the furnace,) and fig. 28 is the elevation upon the line *a b*, the length.

Figure 30 is the tongs for taking out the balls, and fig. 31 the spoon to carry them to the gun.

When there are no furnaces erected in batteries to heat shot, common gridirons are then used; but they are dangerous, and not economical; the balls heat in them but slowly and imperfectly, so that air furnaces are best. When they are used, there must be a large bellows to excite the flame.

Of Firing Red Hot Shot.

To do this with safety, a hay wad may be used, steeped for about 12 minutes in water, and then allowed to drain a little, or else a yarn wad, wound hard, and of a length equal to the caliber of the piece: loamy earth is also used.

In loading, drive home the powder, then put down a wad of dry hay; prick and prime it; put a wet hay wad over the dry one, or else one of yarn, or loam that fills the bore of the piece exactly; then put in the red hot ball, and over it a wad of wet hay, of yarn, or of loam.

In order to avoid all accidents, cartridges of thin pasteboard must be used, or of parchment, perfectly whole, and very carefully examined, to see that the powder does not sift through; the spunge must also be frequently passed into the piece, particularly when parchment is used.

Note. In the old way of firing red hot balls, the shot were of a lower caliber than the gun, and rolled by their own weight down the bore of the piece, that was always elevated. The gun was fired as soon as the ball had rolled down; from these several circumstances resulted a very uncertain fire, and its uncertainty was increased by the necessity of pointing above the horizon, and of the marks being a fixed one. The latter fault prevented its being employed in sea-coast batteries, where it is most valuable. But experience has proved, that a ball, when heated red hot, does not expand so much as not to be able to enter a piece of its own caliber. The expansion of a 24 pound ball is not more than from 4 to 9 points, and it may be safely fired in the above manner.

OF MILITARY BRIDGES.

An army must be provided with the means of promptly passing over the streams it meets upon its route, or else its march may be constantly interrupted. These means are bridges, the parts of which are transported upon carriages, and can be put together in a short space of time. The water courses that are met with being of various breadths and depths, and the weights that are to cross them being sometimes greater than at others, different sorts are needed, that are planned in relation to the service they are to perform.

The bridges usually carried with an army, are either bridges of boats, or carriage bridges.

Other sorts of bridges are constructed, which we shall also mention; but nothing more than the articles needed in their construction is carried with the army: these sorts of bridges are of rafts, of wooden trestles, and of rope; there are also flying bridges, but they come under the head of bridges of boats.

BRIDGES OF BOATS.

Two different sorts of boats are used, (a large and a middle sized.)

1st. Those for permanent bridges over large rivers; they cannot follow the troops on account of their weight, but march slowly in the rear of the army, and are used upon its great communica-

tions.* If this boat will carry four tons, after the platform is laid, it will answer in every case, because a 24 pounder mounted upon its carriage weighs no more. It must also be of such a shape as to prevent it from being forced under by the action of the current.

2d. Boats that are more easily transported, and weigh about 1,100 pounds, are called boats of the advanced guard, and can follow an army in all its movements, march with rapidity to any given point, and establish temporary communications over large streams. Pontoons, or boats of copper, of which we shall hereafter speak, were once used for this purpose, but the boats of the advanced guard are now preferred. The 12 pounder is the heaviest burthen that accompanies a corps of an army; if the boat will carry its weight without sinking too low in the water when the platform is laid, it will be sufficient.†

There is, besides, a boat that can be carried on the back of a mule, being divided across the middle, into two parts. When steep mountains are to be crossed, to carry war into a country, these boats may be useful at first, until others are collected or built. In this case the tools, ropes, and anchors are carried along; and besides the boat-builders, sawyers must accompany the army, to

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* An army need not carry these large boats in its train, unless it is believed that they cannot be found in the country where the war is to be carried on, or when there is no time to build them for the great bridges of the main line of operation.

† To find the burthen of a boat, calculate the cubic contents in feet of the part between the line at which it floats when empty, and that to which it is to sink when loaded; multiply this number by 62 1-2 pounds, the weight of a cubic foot of water, the product will be the burthen of the boat floating at a certain draught of water.

When a bridge is overloaded, every precaution must be taken to avoid the shock the first boat undergoes, at the moment the weight first bears upon it, and which might sink it. Upon a boat of the burthen of 3,100 pounds, when the beams and planks of the platform are placed, and its gunwale a foot above the water's edge, a French 16 pounder weighing, with its carriage, 6,500 pounds, has been borne, when these precautions have been taken. It is a weight, however, much less than the volume of water displaced by the boat when sunk to the gunwale. It is to be observed, that the whole weight is not supported by any single boat, so that in calculating the weight carried by the bridges, that of the draught horses, each of which weighs 400 pounds, is omitted.

get out the beams, planks, &c. Instead of anchors, that cannot always be procured, if they are not carried along; piles, or blocks of stone, into which iron rings and eye-bolts are set with sulphur or with lead, or even bells, are used; nets of rope, and large baskets, are also filled with stones and employed; the latter will only answer upon a muddy bottom. (*Gassendi.*)

An officer must be very intelligent, clear sighted, and active, to direct the service of bridges in a country that wants resources, and where rivers are to be met with at each step; this was sensibly felt in Italy by the French.

The boats for throwing bridges are carried in the train of the army upon carriages that are called haquets; those for the light boats carry also the planks and beams that form the platform; but for the heavy boats of permanent bridges, the timber is carried after them in waggons. When the boats can be carried by water, they are collected into tiers of 4 or of 8, called a train; only one rudder is allowed to each train, with a boatman to direct it, and the men necessary to work it. Each boat, in this case, carries its own haquet, as well as the beams and planks of the platform.

General Rules.

The boats ought to be placed at distances from each other proportioned to their size and the burthen they will have to carry, and in such a way that the weight may never be borne by a single one; this gives more solidity, and, consequently, greater safety.

In permanent bridges they are usually twice their greatest breadth apart; thus, if a boat be $6\frac{1}{2}$ feet wide, the interval between each two will be 13 feet, and the length of each pannel $19\frac{1}{2}$ feet, measured from centre to centre, of two contiguous boats fixed in their place. The beams, or sleepers, ought to project a foot beyond the gunwale of each boat, and will therefore be two feet longer than 4 breadths of the boat. Or in this case, 28 feet long, and $5\frac{1}{2}$ or 6 inches square, the planks are 16 feet long, 1 foot wide, and 2 inches thick.

The light boats are placed at distances from each other equal to one and a half times their greatest breadth; as this is $5\frac{1}{2}$ feet,

the interval will be 8 feet, and the length of each pannel $13\frac{1}{2}$ feet. The beams are 21 feet long and $4\frac{1}{2}$ inches square, the planks 12 or 13 feet long, and $1\frac{1}{2}$ inches thick. Boats fitted for such a bridge are not too heavy to be carried upon a haquet along with their beams and planks; if they were placed at greater distances they must be made larger, and longer and thicker beams would be wanted; the number of planks, too, must be augmented; a haquet would no longer be able to carry the increased load, which would render the construction of bridges less convenient.

Knowing the size and the distance between the boats, it is easy to find the number required for any given bridge. To do this, deduct from the breadth of the river, in feet, two of the intervals between the boats for the distances between the piers and the outside boats,* divide the remainder by the length of a pannel, and it will give the number of boats, less one.

A bridge of light boats may be constructed over a common river, at the rate of a minute and a half to each boat, when the men are skilled in their manœuvres, when the boats are arranged within reach along the bank, and when the beams and planks are equally well disposed, or can be brought by the workmen as they are wanted.

It takes a day to construct a permanent bridge of 80 boats: (it has been often done in less:) 5 hours are allowed for unloading the haquets, and throwing the boats into the water; two hours to put them in order, embark, pass, land, and disembark 1,200 men, and 7 hours to erect the bridge.

Construction of Bridges. (pl. 4.)

In order to construct these bridges with celerity, it requires the number we are about to give of pontoneers, or artillery workmen

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* If the river is not deep enough, near the bank, to permit the first and last boats to approach the pier within the distance of an interval, the additional space must be deducted also; in this case, trestles must be placed to support the beams that cannot reach the boat.

exercised to this service, and half as many more ordinary labourers.†

	Permanent Bridge.	Light Bridge.
Sergeant, at the depot, and to attend the unloading of the boats, - - - - -	1	1
do. do do. of the planks and beams,	1	1
do. at the pier of the bridge, - -	1	1
do. at the pannel that is constructing, -	1	1
Men to convey the beams (two for each,) -	14	12
do. do. the planks (1 to each, if a foot wide.) - - - - - - -	20	14
do. to bring the boats to the bridge, (4 or 2 per boat,) - - - - - -	8	8
do. to place the planks, - - - -	2	2
do. to bring their ends into a straight line by blows of a mallet, - - - - -	2	2
do. to fasten down the beams with clamps, (3 are put into the first boat, who pass into the 3d, 5th, 7th, &c. in succession, and 3 into the second, who pass into the 4th, 6th, 8th, &c.) - -	6	6
do. to assist in casting the anchors, -	4	3
	60	47

It is to be observed that it takes 12 men (6 on each side,) to carry a boat, from its haquet, into the river, so that when the boats are not in the water at the time that the bridge is begun, at least two such detachments must be calculated to carry them.

In general, 80 or 100 men are attached to a permanent, and 60 or 70 to a light bridge ; the surplus of these, over the number in the table, may be detailed from the infantry.

The position being chosen for a bridge, arrange a part of the bank of the river below it, into a ramp 25 feet wide, by which the haquets may enter it for the purpose of being unloaded ; extend this ramp so far into the stream that the haquets may have at least a foot of water above their axle-trees ; launch the boats,

* The Construction of Bridges is, for the most part, taken from the *Aide Memoire*, of General Gassendi.

and arrange them along the bank;* lay the several articles, (beams, planks, cordage, anchors,) upon the bank, each sort by itself in a convenient place.† It is better to draw the boats up the river, to make this bridge, because they are then easily laid across the line of the bridge, by hauling them with a rope from those that are already placed.

Then make the pier or abutment; to do this, raise or lower the ground until it is nearly level with the gunwale of the boat; place some planks at the distance of 6 feet from the water, and parallel to the current of the river, one upon the other, or a short heavy piece of timber to serve as a solid support to the first beams of the bridge; place behind it a plank on its edge, against which these beams but, and whose upper surface is on a level with theirs; consolidate this point of support by stakes in front of, and behind it; make the entrance of the bridge smooth, and of the same height with the ground, by means of earth and fascines, if they are necessary to consolidate it.

A *cinquenelle*, or strong cable, crossing the river at the bow of the boats, to which it was fastened, was sometimes used; it was stretched by capstans fixed upon each bank, or by only one capstan placed upon the hither bank, and attached to a strong stake or tree on the other. But, in consequence of accidents that happened on the Danube and the Rhine, during the campaigns of 1809 and 1812, these cinquenelles appear to have been abandoned; for they consolidate the bridge, only to make it liable to be destroyed in mass; while it is better, in case of danger, to disunite the bridge, by loosening the brailings at intervals, than to let it remain in one body; in this case, the agitation of the waves produces only undulations that are confined in their extent to two or three boats held by anchors, and the whole bridge does not suffer: one or two men, placed at each hawser, at the instant of danger, direct the part of the bridge that is detached towards the bank, and these portions

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* If the bridge is constructed at night, and if it be feared that the enemy may hear the noise of unloading the haquets, and make dispositions in consequence, the haquets stop at a distance from the banks, and the boats are carried on men's shoulders to the river

† In front of the equipage, the tools, &c. to form the piers of the bridge, ought to be laid.

may be easily reunited. Besides, when a cinquenelle is used, the construction of draws is difficult.

Note.—In order to avoid all doubts as to meaning, in speaking of boats placed to form a bridge, I shall call the gunwale towards the bank occupied, the interior gunwale, and that which is towards the bank that is to be reached, the exterior gunwale.

"Bring forward the first boat, and place it parallel to the pier, at a distance equal to that which is to be left between the boats. (This, as we have said above, is either 13 or 8 feet, habitually.) Moor it, bow and stern, to trees, or stakes driven into the bank, at about 5 yards from the pier; and place the beams, (6 in a bridge of light, and 7 in one of heavy boats,) upon the boats; their ends projecting a foot beyond the exterior gunwale; fasten the outer beams with 4 clamps, that being fixed to the inside of the boat, and inserted into the upper surface of the beam, determine the distance between them;* place the other beams parallel to the first, at equal distances of about 18 inches from it and each other, and perpendicular to the gunwales.* Push this first boat forwards, raising the ends of the beams, until their extremity, bearing upon the point of support of the pier, touches the plank placed behind it, or rests on a trestle, if the ground does not permit the boat to be brought near enough.† Bolt, or clamp the beams to the point of support, or to the trestle. (If the bank of the river is high, and cannot be levelled, piles of beams, crossing each other, are made upon the first one or more boats, in order to render this slope more gentle.)

Cover the beams with planks to within two feet of the interior gunwale of the first boat.‡

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* The gunwales have usually holes that receive bolts to determine this position of the beams at once, or else both they and the beams are pierced with bolts.

† When the bank slopes into the channel so gradually as to prevent the near approach of the first boat when loaded, the beams would be either too short, or if lengthened, too weak; in this case, one or more trestles are placed between the pier and the boat, and other beams reach from the trestle to the bank. The trestle must be driven in, if necessary, to bring it to the level of the first boat when loaded.

‡ *Precautions to be taken, and order to be observed.*

The sergeant, who is posted at the depot of beams, ought to see that the men

"While this is doing, bring forward the second boat, and place it opposite to the first; bring up its beams; place them upon it in the same way as those of the first boat, say with their ends projecting a foot beyond its exterior gunwale; fix the outer beams with clamps, and place the others; &c.

Push this second boat forward, by raising the near ends of the planks fixed to its exterior gunwale, until they come within a foot of the inner gunwale of the first boat, upon which they must rest; (thus each boat is traversed by its own beams, and those of the succeeding one.) Observe that they lie all either on the upper or lower side of those of the first boat; make the second beams join close to the first, on the first boat, and fasten them together by two clamps, placed 18 inches from the end of each.

"Moor the second boat in the same way as the first, to trees or stakes driven into the bank, but farther from the pier than those to which the first boat is attached.

"Tie the two boats together by 4 ropes, called mooring ropes; two of these pass through hawse holes, or rings, upon the gunwale near the ends of the boats, and cross from the stem of one to the stern of the other. The two others are stretched directly across from corresponding ends.

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carry the beams upon their right shoulders, and those who carry the plank place them on the right arm, their length in the same direction as the bridge.

The sergeant, who is posted at the pier, will make those who carry the beams and plank, pass in a single file along the right side of the bridge.

The sergeant, who commands where the covering is going on, will make the bearers of beams oblique to the left, to lay the first one of a new pannel, either higher or lower than that which is most to the left of the former ones; the others must be laid on the same side of the corresponding ones. The men who are placed at the end of the beams nearest the pier of the bridge, will file to the left to return to the general depot; those who are at the other end of the same beams will retire and take their place to assist to push the boat, they will then also return by the left. The plank bearers, when they arrive near the pannel that is to be covered, will direct their course towards the centre of the bridge, will lay their plank parallel to the breadth of the bridge, leave it to two men who are posted at the extremity of the beams, to cover them, and return as soon as this is done, by the left, to the general depot.

"Continue to cover the beams, as soon as they are placed, with plank, till within two feet of the interior gunwale of the second boat.

"Bring forward the third boat, and place it opposite to the second; cause its beams to be brought, and place them upon it in the same way as those of the second have been; moor the third boat to the second, as that was moored to the first; cover it with plank, &c. Go on in this way until the bridge is finished, and see that the beams of the boats, whose numbers are even, may be always either above or below those of the boats with uneven numbers.

"The anchors to sustain the bridge are thrown 60, 70, or 100 yards, (in proportion to the depth of the river,*) above it. One is wanted to every two or to every four boats, and moored to the bank, (according as the bridge is permanent or light;) and half the quantity below. Moor each boat to these anchors as soon as it is placed. When the boats are of the large sort, each of them must have a hawser and anchor. Their numbers are, in general, in proportion to the strength of the current, and the quality of the bottom of the river. Anchors are also cast below the bridge, where the tide or high winds are to be feared; in the latter case, only one half the number are laid.

"If some of the boats are of unequal sizes, preserve the largest to oppose the force of the current, and place a trestle in each of them, so that the top of the bridge may be without breaks.† If any of the boats have gunwales, either too weak or too much inclined, the trestle is also used in them.

"In order to make a bridge more solid, it must be bent into an elbow, opposed to the current; it will then resist it more firmly.

"If the bridge has not been begun at both ends, a pier similar to the first is formed.

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* The greater the depth of the river, the farther the anchors ought to be cast from the boats, because the smallest angle that the hawser makes with the bed of the river is the most advantageous; and all these angles ought to be equal. Having ascertained by experience, that a rope 60 feet in length is sufficient for a depth of 6 yards, the length of the hawsers of the other boats may be calculated by multiplying the depth of the water, at the place of each boat, by 10.

† This trestle is not placed in the middle, which would press down the bow, but over the centre of gravity of each boat, and in the direction of its length, so as to carry the platform of the bridge.

"The two last boats are moored to the bank in the same way as the two first.

"If the beams of the last boat do not reach to the opposite bank, or if their great length causes them to run the risk of bending, another trestle is employed.

"Weigh the anchors that have been cast incorrectly and in haste, and place them properly. (*Gassendi.*)

When the bridge is finished, place on each side, over and towards the end of the planks, a double or single row of beams in such a way as to correspond with the outer row below; tie these beams together with a rope 4 or 5 lines thick, that is made to pass between two of the planks, close to the gunwale of the boat. Make a knot in this rope above, and fasten it by means of a strong stick of wood, which is turned round in such a way as to twist the rope upon the corner of the beam; then turn the knot over till the stick bears with its end upon the outside of the platform of the bridge, where it is held by the effort the rope makes to untwist itself, without either clamps or nails, that in case of danger are very injurious. This mode of fastening, that is repeated twice at least to every boat, gives great solidity to the bridge, and especially prevents the planks from quitting their places when carriages pass, or when the bridge is swinging round.

Bridges are also constructed in pannels, that is to say, of parts consisting of two, four, or even eight boats, joined together and fitted into a bridge; these different parts are placed successively, using for that purpose the portions that are first placed, and haling the others to them with a rope. This method is very expeditious; a bridge of 8 or 900 yards may be made in this way in 4 or 5 hours, if there are labourers enough to construct all the separate pannels at the same time; besides, it is attended with less danger from the current or the enemy, particularly if the operation is covered by an island, or is conducted at the fork of a branch of the river, where the boats are launched and the pannels formed.

Of the Draw.

That the navigation may not be interrupted, make a passage or *Draw* in the bridge, that may be opened and shut whenever it is necessary.

This draw consists of 2 or 3 boats fixed to each other bridge fashion, and by two beams to the adjoining ones: the ends of these beams of the opening, are sawn off about a foot from the outside of the gunwale, and a plank is nailed against them; the same thing is done with the boat on the other side of the opening; in this way the draw enters easily into its place, and without entangling itself with the beams of the two adjoining boats; a little play may even be given by leaving an interval of some inches between the planks nailed as above described; this space may be covered with a plank. The draw is fixed to the rest of the bridge by means of two connecting beams held by two iron collars, called *Prussians*, that embrace the beams of the platform of the draw at one end, and those of the bridge at the other. In order to fasten these collars, two wedges are driven with sledge hammers, into their upper part, in opposite directions. This method is more commodious than false beams that slide under the platform.

Choose for the place of this draw, that part of the river where there is most water, and where the current is the most rapid, for there boats will find it least difficult to pass. Let us suppose that this point is immediately next to the third boat; place the boats that are to form the draw opposite to it; then bring them near the third boat, so that the planks nailed upon the ends of the beams may be near each other; fasten one side of the draw to the third boat of the bridge by means of two beams and their iron collars as described above. Join the other side of the draw to the following boat in the same way.

Moor each of the boats adjoining the draw to an anchor, in order to preserve the solidity of the bridge. Moor one of the boats of the draw to an anchor, by paying out the hawser of which the bridge is opened.

To open the draw, take off the collars by driving out the

wooden wedges, then remove the two connecting beams, and lastly the plank that covers the two intervals at the place where the draw meets the two adjacent boats; let the draw descend the current, by paying out its cable; when it has floated a few feet below the bridge, it is drawn to one side to leave the passage free.

To shut the bridge, bring the draw opposite the opening again; draw it back to its first position by haling in the cable; replace the connecting beams.

Bridges must be opened as seldom as possible, because this manœuvre always disturbs them in some way or other.

Of Swinging Bridges of Boats round.

"If the enemy advance against one of the banks of the river, say for instance the right, and it is wished to swing the bridge round to the left bank. The following is the mode of executing the manœuvre, and the precautions that are to be taken.

"The bridge ought to be constructed in the most solid manner possible, as we have described above. The boat at each end of the bridge must be fastened to the contiguous one by false beams, only so that it may be more easy to detach these boats that cannot swing with the rest of the bridge.

"Tie a rope of at least two thirds of an inch in diameter to each end of the last boat but one on the right, and pass these ropes to the left bank, one above the other below the bridge, keeping them on the same side as the end of the boat to which they are fastened; place 10 or 12 men above the bridge and as many below it, at distances from it equal to its length, to hold on these ropes, and draw them tight when necessary.

"If the bridge does not consist of more than 20 boats, moor the third boat on the left by a large hawser 160 yards long, to a strong stake, driven into the left bank 30 or 40 yards above the bridge, and as near the water as possible, so that its action may not be too oblique. If the bridge consists of as many as 36 or 40 boats, the 5th or 6th must be moored to this stake, for as the right end of the bridge must swing more rapidly than the left, this rope is needed to hold the latter back: the longer the bridge the greater need has the left end of being supported; this becomes less and less difficult

in proportion as the rope that serves as a pivot is brought nearer to the centre of the bridge.

"Separate the last boat from each end of the bridge, and if there are cinquenelles detach them.

"Draw upon the rope that is tied to the last boat but one on the right, and held on the left bank below the bridge. Slacken all the hawsers of the anchors, which 3 or 4 men, (according to the force of the current,) left upon each pannel, pay out, supporting the bridge and preventiug it from bending unequally; they will not abandon it to the current, but in proportion as the left end of the bridge descends.

"Slacken the rope that supports the left, until the bridge swings entirely round to that bank, and support the right end of the bridge by the rope that extends from the last boat but one, to the left bank, above the bridge, so that the movement may be made in a uniform manner."

"In order to hasten the progress of those parts of the bridge that are in still water, the boats of these portions may be fastened to small row boats that tow them.

"This manœuvre gives a rear guard a chance of retreat, after having fought to the very last extremity; it does not require more than a quarter of an hour to execute, if 2 or 3 hours have been allowed for preparation. It is always practicable, even on a very wide river." (*Gassendi.*)

To replace the Bridge.

"The bridge may be restored to its first position, by a manœuvre the reverse of the preceding one. 1st. The ropes fastened to the ends of the last boat but one on the right, (become now the last as one has been taken off,) must be passed to the right bank, along with the men who manœuvre it. That which was paid out by the men above the bridge, is then haled from a position on the right bank opposite to its former one, and the other is drawn by men who mount along the river in proportion as the bridge is moved up. (The capstans are replaced, and the cinquenelles, if there are any, stretched a little.)

3d. The boats must be replaced, by drawing them to their first position, and haling upon their hawsers. These three manœuvres

ought to be performed together, quickly, and combined so well, that the bridge may not be broken; it will suffer a great deal in spite of every precaution.

"The manœuvre by which a bridge is returned to its first position, is very difficult; although it has been several times executed with success upon a considerable branch of the Rhine; but it cannot be hoped, that it will ever be done upon the Rhine itself, or any other river of that size, where the bridge would be of more than 20 or 25 boats.

"It will be always prudent, when a bridge is to be remounted in its original position, to do it by portions of 4, 6, or even 8 boats, joined together into a bridge, and placed successively; this is called constructing a bridge by pannels." (*Gassendi.*)

"*To fold up a bridge of light boats,* (or to take it apart and carry it away.) Bring the haquets, with their horses harnessed to them, down to the bank of the river, or at least to the place where the ramp begins; take off the planks, beams, and other furniture, beginning with the boats that are upon the side that is to be abandoned; separate the boats that are uncovered from their cables, in succession, and bring them over to the side you occupy; let the planks and beams be placed upon the haquets, but by different men from those who bring them from the bridge; raise the boats out of the water by hand, and place them upon the haquets.

"If it is done under fire of an enemy, keep the carriages at a distance from the bank, under cover, and bring forward no more than 2 or 3 of them at a time."

A bridge may be also taken apart by separating it into pannels of from 2 to 4 boats, and bringing them to the bank, where the work is completed.

OF KEEPING BRIDGES IN ORDER.

"Place sentinels at each end of the bridge, and at regular distances along it, who will see that the following orders, are strictly observed.

"1st. Not to permit a column of carriages to pass over the bridge at the same time with a column of infantry, for the foot soldier does not march with confidence beside carriages, because their weight

makes the bridge undulate, deranges the planks, and because he fears to be thrown down by the horses, who may deviate to the right and left. Two columns of infantry can be permitted to pass over at a time, only when bridges are constructed upon boats found in the country, which are usually larger than those that can be carried in the train of an army, and in this case a separation is made in the middle of the bridge.

"2d. Never allow a number of carriages to pass over a bridge at once, but let them go upon it in succession, and at certain distances from each other. so as not to load it too deeply; for the same reason, two carriages ought never to meet upon a bridge.

"3d. Cavalry must pass over a bridge on foot, holding their horses by the bridle, and marching in the middle of the bridge, not more than two or three abreast. A horseman must never pass on a trot, even if he is alone.

"4th. Droves of cattle should either not be permitted to pass over a bridge of light boats, or should be prevented from crossing in a single body, because, by crowding into one mass, they would probably sink it.

"If the river, over which the bridge is thrown, carries trees, &c. with it, in consequence of torrents that flow into it. or if the bridge is within reach of the enemy; place several outposts opposite to each other, along the banks of the river above the bridge, who will stop all dangerous articles, and whatever the enemy may send down to break the bridge, or will give information of their approach, so that it may be opened and preserved. But little dependence is, however, to be placed on receiving information in time; and when such attempts on the part of the enemy are to be feared, a stockade must be made.

There are also small boats kept at hand; they are rowed in front of the articles carried down by the current, to seize them with grappling irons, fixed to the bank by ropes; the water itself will then carry them thither.

"As regards ice, it must be broken as soon as it forms round the boats; and in time of thaw, the boats, ropes, &c. must be secured from it, or rather, the bridge folded up in season.

"If the bridge is to continue a long time: examine the boats often; heave upon the anchors of the boats from time to time, to preserve the bend that the current gradually destroys. Take

up the anchors from time to time, that would otherwise bury themselves so deep that they finally could not be raised at all; but in order to avoid these labours, cast blocks of stone, and use piles instead of anchors.

"Workmen must be constantly employed, to restore to their place the planks, that are deranged by frequent passing; and pontoneers to bale out the boats.

"The draws should be opened as seldom as possible, for this manœuvre always deranges the bridge; wait until several boats are collected together for the purpose of passing; watch for the boats and stop them, before they approach near enough to do harm, and thus gain time to open the bridge. (The boats of a navigation are usually stopped in a place chosen for the purpose, in order to let them pass every morning and evening at a fixed hour.)

"If the bridge is constructed near the mouth of a river, subject to the flow and ebb of a tide, the boats must be held at each end by an anchor. When the flood is first perceived to make, hale taught the hawsers of the anchors on the lower side. Perform the same manœuvre on the opposite side when the tide ebbs. These bridges demand constant attention. (*Gassendi.*)

OF PONTOONS.

Copper boats, called Pontoons, were formerly used for a light bridge equipage; but they have been abandoned, because they will not answer to make bridges over rapid rivers that are more than 200 yards wide, but only over those that are still; neither will they serve for the passage of men, who must often be sent in numbers to the opposite bank, before the bridge is established. Besides, it is only possible to carry them by water in the quietest streams, on account of their form, that presents a great surface to the current. Even in this case, a pontoon will not carry its haquet, nor even its planks and beams, on account of their length, and the risk of piercing its copper covering. The pontoon is advantageously replaced by the light boat of the advanced guard.

The pontoon is composed of a skeleton of wood covered with

sheets of copper firmly nailed to it. Its weight is 1280 pounds, (*French*;) its greatest width, 4 feet 4 inches, its least 4 feet 2 inches; its depth 2 feet 4 inches; its length, at top, 18 feet, and that at bottom 13 feet 4 inches, (*French Measure.*)

OF CARRIAGE BRIDGES.

The Carriage Bridge is a carriage composed of two pair of wheels and their axle-trees, connected by a perch, and which carries its own platform. The carriage way is laid upon the two pair of wheels that form the piers of the bridge.

This sort of bridge can only be constructed over streams that are not more than 6 feet deep; and as the whole extent of a bridge composed of a single carriage is only 42 feet, if the stream be wider, trestles must be added at either one or both ends to support the platform, or else several carriage bridges arranged in a file.

These bridges may serve for advanced guards; guns of small caliber can pass upon them; they are, however, little used. We shall, notwithstanding, give the mode of manœuvring them.

To Establish a Carriage Bridge.

It takes 12 men only 8 minutes, if they are well drilled pontoneers, or artillery workmen.

Having arrived upon the bank of the river at the place chosen for the bridge, take off the swing trees of the leaders from the pole, the keys, the pointed hooks, the supports,* the Roman pin† nearest the end of the pole to facilitate its play. Fix the prolonges in the lashing rings, and leave the end of that which is attached to the limber, on the side of the stream where you stand.

Unload the beams and the shutters,‡ and separate the fore

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* The supports are pieces of wood placed in the forks of the upright, to support the beam of the platform.

† See Nomenclature.

‡ The shutters are planks framed together to form the platform of the bridge; they are seven feet long, two and a half wide, and one and a half inches thick.

wheels from the hind to their greatest distance, place the two supports at the proper height by means of the four Roman pins, then lay those four beams, that have a hinge bolt at each end, upon them; place four of the other beams upon the limber to form the ascent to the bridge on that side, taking care that the two outer ones are those that have a plate on them pierced with several holes. Fix these beams by their keys.

Drag the carriage into the river, guiding it by the pole, until the beams on the limber rest on the opposite bank. If the beams are not level on account of the unevenness of the bottom, raise or lower the support by placing the Roman pins in the holes that answer best.

Lay 6 large shutters upon the beams that form the end of the bridge, then one of the small ones at the elbow of the end and the body of the bridge, and 6 large ones upon the body of the bridge.

Place the four remaining beams so as to form the other end of the bridge; rest their extremities upon a small trestle, if they cannot reach the bank of the river; place upon them the second small shutter, and finally the six other large shutters.

To lay a second Travelling Bridge, if required by the breadth of the stream. The second slope of the first is not formed. There are among the furniture of travelling bridges, two spouts, or troughs, in which wheels can run; one end of them is placed upon the support, and against the forked uprights of the back of the first bridge, the other in the stream, being laid parallel to each other, and at a distance equal to the breadth of the wheel track.

Pass the second bridge over the first, and causing its wheels to enter into the troughs, lower it into the river, and push it so far that the beams may reach from the support in rear of one to that in front of the other; the rest of the manœuvre can be easily understood from what has been already said.

To fold up the Bridge.

Take up the shutters of the end that rests on the far back, and its two interior beams, then raise the other beams by means of

the prolonge that reaches to that side. Take up the other shutters and beams, and withdraw the carriage from the water.

To load the Carriage.

Bring the fore wheels nearer to the hind ones; place, first, the 8 beams of the ends between the forked uprights; lay the 18 large shutters upon them, 9 on one side and 9 on the other, touching each other exactly in the middle of the length of the beams; place the remaining 4 beams upon the top of these, 2 to the right and 2 to the left, resting upon the forked uprights; put in the keys and bolts that fasten them; place in the interval of these 4 beams, the two small shutters, the two supports, the two hooks; lash the whole together with the two prolonges.

OF FLYING BRIDGES.

"A flying bridge is composed of two boats attached together, covered with a platform, and sometimes of only one boat with a platform; it is held by an anchor cast into the river, or fixed to a stake or tree upon one of the banks. The cable must be at least long enough to reach from one bank to the other, and it will be manœuvred more easily and rapidly in proportion to its length.

"The cable is supported upon small boats, barrels, &c. so that it may not be entangled in the bottom of the river.

"The flying bridge may be moored with a rope to each bank of the river, and may be haled by each in turn, while the other serves as the radius of the arc it describes in crossing the river.

"A convenient passage from one bank to another, on a stream not more than 100 or 130 yards wide, may be made by means of a raft moved by the force of the current. For this purpose, stretch a cable across the stream; form a raft, that instead of being square is cut into the form of a trapezium, at an angle of 54 deg. 44 min. Fasten it by two ropes to two moveable pullies,*

* It is more convenient to have three pullies upon this cable, on account of the change in the points where the ropes are fastened, but no more than two are used at once.

that run upon the cable; these ropes are fixed to each acute angle, and to a ring placed upon each of the sides that form it, alternately; for it is necessary that the side of the raft next the bank towards which it is moving shall be in the line of the current, while it strikes the opposite side at an angle of 54 deg. 44 min. which is the most advantageous, to produce the desired effect of moving the raft, from one bank to the other, by the force of the current alone.

"As to the length of these ropes, that which is fastened to the acute angle must be equal to the height of the cable above the water, and the other is the hypothenuse of a right angled triangle, one of the sides of which is equal to the first rope, and the other to the shortest horizontal distance between the rings and the vertical plane of the cable; this line, making an angle of 54 deg. 44 min. with the side of the raft.

OF BRIDGES OF RAFTS.

"Bridges of rafts may be used upon very large rivers; they are quickly made, and soon removed on still waters; they require less previous preparation than bridges of boats, and are very valuable when a bridge equipage cannot be transported. They are extremely convenient to conceal a rapid passage of a river when wood is near to construct them.

"In Italy the French have thrown a bridge of this sort of 360 yards in length in four hours, and taken it apart in two; it was composed of 34 rafts. At the retreat of Deckendorf, by the Count de Saxe, in 1744, one was thrown across the Danube in the course of a morning, and swung round afterwards to the bank."

In Spain they crossed the Tagus under the fire of the enemy, by means of a bridge of rafts constructed along the bank during the night; it was brought down to the place chosen for the passage, and one end of the bridge fixed to the hither side of the river; the other was then pushed off and abandoned to the current, that swept it round to its place. Infantry was posted upon it to leap on shore and oppose the enemy.

"The rafts ought to be made of the lightest kinds of wood, and

commonly of pine. They are joined together by poles that serve as traverses, and fastened with withes of willow and wooden bolts; iron fastenings are sometimes used; the whole is then covered with planks.

"Large rafts are composed of 34 trees, (pines,) 40 feet long and a foot in diameter; 60 of these will make a bridge of 800 yards. The logs are sometimes placed touching each other, and at others six or seven inches apart, for the water to pass.

"The heavier the load the bridge is to bear, the greater must be the care that is taken not to crowd the logs too close, and it may become necessary to construct the rafts of two or three tiers crossing one above the other, so as to raise it to a greater height above the water. This is more particularly proper in a raft employed to pass a river by main force, and under the fire of an enemy; for in this case a number of troops is placed upon it, and even guns of small caliber, and it is sometimes lined with wool sacks. This mode of crossing rivers was often employed successfully, by Charles XII. (see "the Framed Raft," at the end of this article.) The end of the logs that is towards the stream, is called the stem, and is cut into the form of a cone, at least diagonally across; the opposite end that is called the stern, is cut off square.

Solid bridges, (or without openings between the rafts, or the wood that forms them,) may also be made, but they can only be established over gentle streams in consequence of the resistance they oppose to the passage of the water; these may be crossed in case of need without any platform, but fascines and branches must be laid in the hollows between the logs.

*Solid Construction of a Permanent Bridge of Rafts over a rapid River.**

"In constructing the rafts, place the logs 6 or 7 inches apart, so that the bridge may oppose less resistance to the action of the

* During the brilliant Italian campaign of 1796, Colonel A——, of the French Artillery, constructed a bridge of 130 yards in length over the Adige, which remained for two campaigns. Each raft was 50 feet in length, and 15 wide; the trees were 15 inches square, and laid 6 or 7 inches apart.

water. If the platform rests upon blocks of wood, these intervals will be convenient for placing them and fixing them in any way that may be thought proper. Employ rafts of great length; they will carry more, and will be firmer.

"Leave intervals between the rafts, proportioned to the strength of the beams of the platform.

"Place the platform (which is composed, like that of other bridges, of beams and planks,) rather towards the stern than the stem of the raft, so that the water may be less likely to rise over it in floods; it may even be necessary to load the interval between the platform and the stern of the raft with stones and logs of wood; from this it may be seen how advantageous it is to have long rafts.

"If there is a cinquenelle across the river, as in a bridge of boats, moor each raft to it by a single rope, passing round it, and fixed at each end to the stem of the raft. When there is to be a draw in it, the cinquenelle must be supported upon lofty posts.

"Fix every other raft by a hawser to an anchor, and moor the two first and two last rafts to stakes, or trees driven into the bank nearest each of them. Fix the rafts, to each other, near their stem, by means of a strong beam that reaches from one to the other, and is carefully bolted down.

"Make the opening, if there is to be one, at the place where the current is strongest, as has been directed for bridges of boats; and employ two boats fixed together, bridge fashion, for the draw; this will require two ramps to be made in order to join it to the ends of the bridge; these are moveable, in such a way that the draw may pass out from, and return to its place. (The reason of employing boats to form the draw is this: the height of the upper part of the rafts above the water being no more than 4 inches, is not sufficient for the draw-bridge, which, on account of the rapidity of the current, ought to be at least a foot above its level, that it may not be covered by the water when it is drawn up the stream to close the opening.)

"If it be wished to avoid making ramps, that are, in fact, difficult to place in practice; raise the whole length of the bridge, by means of 3 blocks of wood placed upon each raft, that carry the beams of the platform; these are fastened with clamps to the

outer logs of each raft in the same way as the beams to the gunwales of boats.

"Make the draw firm, by fastening it strongly to the bridge, by four stout timbers, that reach to the rafts on the right and left of the opening. This mode of joining them renders the bridge solid, and opposes the tendency that its two parts have, to open in time of floods, and swing to their respective banks.

"If the rafts are made of round logs, the places where the beams of the platform are to lie must be smoothed with the adze, so that they may fit more firmly.

"Lay upon each side of the bridge a course of timbers, that are to be tied to the outer beams of the platform, and strengthened by being brailed to it by a rope." (*Gassendi.*)

This mode of crossing rivers is peculiarly applicable to America, where the banks of the rivers are furnished with wood, of which one of these bridges may soon be made without being furnished with many implements. Other bridges of logs may also be made in particular circumstances, such as those used by General Jackson in his campaign in Florida, in 1818.

The army was without any thing in the shape of bridge equipage, and but ill provided with pioneers and edged tools, yet with all these disadvantages, it performed a march of astonishing extent, in which it traversed many very deep and rapid rivers.

The streams in that country are usually very deep and rapid, but seldom very wide. In cases of this sort, trees were felled and laid projecting over the stream; they were held firmly in their place by the weight of the part within the pier, or by being strongly staked and lashed down. In some instances, two of these, one projecting from each bank, met in the middle, and were sufficient; in others, it became necessary to lay a third to connect them, which was strongly lashed to the two first, and then formed but one body with them; when the streams were wider, arms, formed by piling logs vertically over each other, and supporting them by counterpoises and strong fastenings on the shore, were pushed from each bank until they joined; in one instance, where the banks were of unequal height, an arm of this sort was constructed on the higher one, until it became possible to reach the opposite bank with two long poles, on which a road like a ladder, but much more inclined,

was formed. To cross a stream of too great a width to permit these methods to be adopted, canoes were hollowed out of trees, which, when lashed together, formed excellent rafts, and would have made good flying bridges. Artillery was not carried over upon any of these erections, but many of them were firm enough to have borne it. Instead of ropes, branches of the wild vine were used; they form an excellent substitute for cordage, and may be met with in every part of North America, that has been explored. Tr.

Bridges are also constructed without leaving openings between the logs that form the rafts; each of these rafts may then serve as a draw, which is very convenient for the navigation.

FRAMED RAFT.

This raft is composed of a frame made of squared pine logs, it is 16 feet long and 10 or 12 wide; several rows of boxes pressed close together, are placed under the frame; (each box is 4 or 5 feet long, and two deep;) the frame is covered with boards that are nailed to it. Several of these frames are joined to each other with strong mooring ropes and ends of timbers to make a moveable bridge. Hooks of iron may be fixed at the ends to lay hold of the earth, and prevent the raft from being carried away by the current.

Rafts are made in this way for the purpose of disembarking troops; uprights, in the form of trestles, are placed at each end of the raft for the purpose of supporting oars; the side exposed to the enemy is covered with a blind of 5 or 6 feet high; and the soldiers are formed upon it in close order, as if on shore. Each raft has a pair of mantlets 7 or 8 feet high, that are raised and lowered in the manner of a swing draw-bridge; these are lined with matrasses that reach down to the water, and defend the frames from a fire of musketry.

Instead of boxes, the skins of deer may be used filled with air. A single waggon will carry enough of them for 6 rafts that will disembark 7,500 men at a time. (*Gassendi.*) See also *Folard.*

BRIDGES OF BARRELS AND ROPES.

Floating bridges may be made of pitched barrels, connected together by means of ropes, on which a slight platform of light boards is laid. These, however, will answer only for infantry, and with the precaution of making the men pass at suitable distances, that the bridge may not be overloaded. They can only be erected over narrow streams, and those that are not rapid.

OF BRIDGES UPON TRESTLES.

Trestles, made like the wooden horses on which tables, scaffolds, &c. are raised, are sometimes used in order to pass shallow rivers. They are placed at proper distances across the river, and beams, (covered with planks,) are laid from the one to the other, forming a platform like that of a bridge of boats.

"These trestle bridges ought to be established only over tranquil streams, that are not more than 4 feet deep; for there must be at least 2 feet between the mean height of the water and the bottom of the platform, to prevent it from being carried away by floods; and trestles that are more than 6 feet high are difficult to place. They may, however, be sometimes made as high as 8 feet, and used in streams that are a little deeper.

"The intervals between these trestles ought not to be less than than 9 feet, nor more than 12, in order that the beams may have a proper bearing: as to the size of the beams, 4½ inches square will be enough if the bridge is to carry nothing heavier than field pieces, and they may be 16 inches apart; but if battering pieces are to cross upon it, the beams must be as large as those of the permanent bridges of boats, say 5½ to 6 inches square, and the distance between them not more than 12 inches. It is evident that all the rest of the construction must be relative to the weight it is to bear, and the size of the wood that can be procured.

Of the Trestle.

The trestle is composed of: a head piece, (on which the beams of the bridge rest,) from 12 to 16 feet long, and 6 or 8 inches square; four feet that support it, they are usually 6 feet long and $4\frac{1}{2}$ inches square; and two traverses of 2 feet 10 inches in length to connect the feet near the bottom.

In mountain roads, which are often narrow and between steep banks, reduce the length of the trestle, its planks and beams, to 10 feet, if necessary.*

The trestles ought to be solid and easy to put together. If the bottom, where the trestles are to be placed, is too muddy, such as a marsh, &c. form beds of plank of the form of a double T to support their feet.

Construction of a Bridge upon Trestles.

Men necessary	Soldiers.	Non-commissioned officers.
To prepare the banks of the river, and place the planks that are to serve as a solid support for the first beams, ...	4	1
To place the capstans, the cordage and the beams,	12	2
To bring the trestles and place them, .	20	2
To bring the beams and planks, . .	17	1
To superintend the pier and the platform, .		2
Total,	53	8

"The position being chosen, unload the trestles and the pioneers' tools near it. Collect the trestles together near the bank.

"Make the slope that leads to the bridge gentle, and raise or lower the ground of the pier to suit the height of the trestles; then consolidate it.

* When trestles are to be carried, they ought to be made of seasoned wood, for that which is green weighs twice as much; in this case they ought to be of the smallest dimensions we have given above.

Place the first trestle 10 feet from the shore,* making a right angle with the direction that is to be given to the bridge; lay upon it 7 equidistant and parallel beams, 16 inches apart and reaching 6 inches beyond the head piece of the trestle. They bear for the length of a foot upon a plank on the pier, to which they are fixed with clamps. Bring down the 10 planks of the pannel, and place them across the beams at right angles to them. (It is to be observed, that the beams and planks must be carried down in the order prescribed for the formation of a bridge of boats, say in general terms that the loaded men enter in file upon the right of the bridge, and leave it by the left.)

"If the bridge is to be secured against a rapid current, place two large cables, to which the trestles are fastened, if they have no braces, (*arc boutans.*)† Tie each of the trestles in succession to the two cables, by fixing the mooring rope to them with a boatman's knot, and then to the trestle, where it embraces the head piece behind the insertion of the feet; this is done either by means of boats or of men who wade into the water. If the season were cold, and boats not to be had, the mooring ropes might be tied to the cables, at distances of 10 feet, before they are stretched; they are then stretched till the mooring ropes are opposite to the trestles; the mooring rope is caught with a hooked pole, and tied to the trestle.

"Place two skids parallel to each other, and 6 or 7 feet apart, butting at top against the head piece of the first trestle, and resting upon the bottom of the stream near the place of the second trestle, thus forming a slope towards the exterior bank. Bring the second trestle to the end of the covered part of the bridge; tie each end of the head piece, outside of the feet, with a mooring rope forming a slip knot; set three men to hale upon each mooring rope; lay

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* Ten feet being the length of one of the pannels of the bridge, that is to say, the breadth that is allowed between the trestles, taking into view the strength of the beams and the burthen they are to support.

† A brace to oppose the action of the current is a piece of wood, 14 feet long and 8 inches square, having a fork at one end that embraces the head piece of the trestle, and is rendered moveable by means of bolts that traverse them. The foot of it is shod with iron.

hold of each of the two feet that are to stand on the near side of the trestle, with a doubled rope, beneath the traverse, and post a man to hale upon each of them. Let the second trestle slide forward, feet foremost, upon the two skids, holding it back by the ropes; when it reaches the bottom, push it with forks to place it upon its feet, parallel to the first trestle, and distant from it 10 feet. If it is too far off, it is drawn back by haling on the double ropes that hold the feet.

"Take away the two beams, and the two doubled ropes, that have served to place the second trestle; bring forward the seven beams; place them with one end upon the first trestle, and supported by forks, until their other end rests upon the second, their extremities passing about 6 inches beyond it, and all pairing with the beams of the first trestle; fasten their ends together with clamps, and the outer beams and centre one to the head piece of the first trestle with clamps also.

"Cover the beams with the planks, as far as the head piece of the second trestle, and draw off the ropes that were tied for the purpose of lowering it. Moor it to the cables, if that is to be done.

"Place the other trestles in the same way. Observing that the beams of even trestles must be all either above or below those of uneven trestles, as has been described in bridges of boats.

Make the second pier, and smooth the ramps that lead to the other end of the bridge.

"Place on both sides of the bridge over the planks, for the purpose of keeping them in their places, a course of beams, corresponding with the outer beams of the trestle, and overlapping each other a foot; unite their ends together with clamps; tie them to the beams below, with bits of rope, passed through intervals made by pushing the planks aside.

If the bottom of the river is muddy, and the trestles have been laid without bottoms of plank, or if these are not sufficient to keep them from sinking into the mire, or when it is feared that they may be undermined by the water, support the beams by stakes shod with iron, planted directly against them, until the bottom of each head piece rests upon the head of a stake; fasten the trestle to the stake, so that they cannot separate, with either clamps or cordage: in the last case, there must be a hole in the stake, at

the distance of three inches from the head to pass the rope through, or a notch to hold and hinder it from slipping.

OF BRIDGES OF ROPES.

These bridges are intended to be thrown over deep ravines, impetuous torrents, &c.; when the rapidity of their currents, their lofty and steep banks, do not permit trestle bridges, nor those upon poles or of any other description to be made over them; or when the time and means of making others are wanting.

These bridges will, probably, not be necessary in this country. We shall, however, describe the means of forming them. Two strong *cinquenelles* must be stretched from one bank of the river to the other, exactly parallel, and 10 feet apart; these fix the breadth, and direction of the bridge. These cinquenelles are raised upon a wooden frame, (like a gin, but with four legs, and a pully at the top,) and are stretched behind it with capstans, so that these cables may be elevated, at the lowest point of their curvature, at least two feet above the highest water that is to be feared, and may be nearly level with a large trestle placed at each end of the bridge near the water, on which the pier is to be formed; the ends of the cinquenelles are fixed to firm and solid points in the rear. Six longitudinal cables are drawn across the river, passing through grooves cut in the two trestles, and fastened upon each bank to a stout stake, or to a capstan; the pier is made of beams about 20 feet long, laying one end on the bank, and the other on the trestle, and planks are laid across them. At 10 feet from the nearest trestle, and at distances of 10 feet, until the other is reached, beams called traverses, are attached to the cinquenelles, to support the longitudinal cables we have already mentioned, on which the planks of the platform are to be laid. These traverses are hung below the cinquenelles by means of mooring ropes strongly fastened to them before hand, at distances of 10 feet, with an artificers knot, and an iron pin that passes through it; each mooring rope is furnished with two pullies, one of which is fastened to the cinquenelle by a rope fixed to its block; two men placed on the ascent to the bridge, one beside each cinquenelle, draw each a mooring rope towards them, by means of a pole with a hook, they fasten the other pully to the eye bolt placed at each end of the traverse, (they re-

ceive this from a third workman, and then pass it beneath this traverse,) they also tie the mooring rope for the moment. Three other men bring five planks pierced at the extremity; one end of each of these is fastened to the traverse with a bit of cord, and the traverse is gently pushed till it hangs perpendicularly; the planks are then firmly fastened behind with clamps; the two men then return to their mooring ropes, and hoist the traverse to a level with the trestle at the entrance of the bridge.

The remaining traverses are placed in the same way; when the other bank is reached, the second pier is made, and the longitudinal cables stretched; the planks placed lengthways are withdrawn, and laid across the six cables to form the platform of the bridge. A rope is placed through the rings, fixed at each end of the planks, and drawn tight upon each bank.

In order to diminish the oscillations of the bridge, two ropes are attached to the middle of the curve of each cinquenelle, and fastened to the two banks.

The weight that the cinquenelles will have to carry, if we suppose that there are no more than twelve traverses, or 130 feet of hanging bridge, is about six tons of wood and cordage. If to this be added, the greatest weight it may have to support, which is that of 40 files of three men each, marching at three feet from each other, we shall have 17 tons,* or $8\frac{1}{2}$ tons to be borne by each cinquenelle, and nearly $4\frac{1}{2}$ by each trestle, or point of support, without reckoning the effects of the power that stretches the cinquenelles, which weakens them still more, and loads the trestles.

The three important points to be examined are these:

1st. The cinquenelles and their torsion; 2d. The points of support; 3d. The points of resistance that sustain the cinquenelles. A cinquenelle of a bridge of boats, if well made, and of good hemp, will bear a weight of $11\frac{1}{2}$ tons without breaking.

As a point of support to the cinquenelles, there is at each extremity a trestle with four feet, each half of which is like a moveable gin, without the foot, having a block and a windlass; in this

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* A bridge 130 feet long, would not have more than 13 horses to support at a time, because they march in a single file; this would be a weight of no more than 5,000 lbs. Guns are dragged over them by men.

way each cinquenelle will be borne by two blocks resting upon four wooden feet.

As for the points of resistance, to which the ends of the cinquenelles are fixed; the position may furnish trees or rocks round which the cordage may be wound; they may also be obtained by means of piles shod with iron, driven into firm soil; or by miners iron grapnels in rocky places, or large iron rings with eye bolts set into the rock with lead; or even by means of the anchors that are used in bridges of boats. The points of resistance must be well secured, if it be wished to avoid the greatest and most sudden accident, the fall of the bridge. (*Gassendi.*)

This method may be used to re-establish the communication across a bridge, one of whose arches is broken, as was put in practice by the English, at the bridge of Alcantara, in the campaign of 1810. The cables that supported the platform were attached by tackles to beams, which were lodged in the masonry.

OF CHOOSING THE PLACE FOR BRIDGES.

Bridges should be, for the most part, established at a re-entering part of the river, (as is shown, vol. 2. pl. 2. fig. 26 and the following ones,) because the batteries intended to protect the passage, will then cross their fires over the ground occupied by the enemy on the opposite bank, and take the approaches to the bridge in reverse.* A straight part of the river is to be preferred to a bend forming a salient angle, because the enemy may take the latter in reverse. Neither must the banks be so much elevated as to render it difficult to establish ramps; this elevation depends upon the sort of bridge; in a bridge of boats, for instance, the platform is three feet above the water, and if the bank is no more than seven feet high, there will be only four to cut into a slope, which is but little; it is evident that the banks might be much higher without causing too great a labour in the construction of ramps, (a slope, whose length is six times its height, is not too steep.)

Positions, where the far commands the hither bank, must be avoided, as well as those where the shallowness of the water

* It is to be observed, that if the re-entering part of the bank be too deep and too narrow, the enemy has it in his power to enclose you in it.

would expose the boats to take the ground in a dry season; or where the length of the bridge must be augmented in a flood. The latter case occurs often at bends, because the water runs with force against the elbow, and is in consequence deep, but is shallow on the opposite side; this compels the preparation of additional articles to lengthen the bridge on that side in times of flood, and exposes the boats to strand when the water falls suddenly. To remedy this inconvenience, place a trestle to the right and left of each boat, so that when the water falls, the trestles will support the bridge before the boat takes the ground, and when the water rises the boat supports both the trestles and the bridge.

"If the banks are upon a level, choose a point where the farther one is most open, and most favourable to the action of your artillery. If the far bank be found to be embarrassed with hedges, bushes, &c. it is then necessary that the first bank should command it, and that the obstacles upon the second may not impair the effect of artillery, and are neither too wide nor too difficult to be rendered practicable, like morasses, &c. that should never be found at the end of the bridge.

"In choosing the position of a bridge, do not fail to employ the islands that are sometimes in the middle of rivers. The bridge will be shorter, the range less, and the current less rapid in this place; but it may be attended with the inconvenience of dividing it into too many parts. For this reason the position should not present more than 2 or 3 islands, and their soil must be firm, to bear the road that is to be made over them.

"Avoid constructing a bridge below bends covered with wood or with rocks. But if such positions must be taken, establish several posts along the river above the bridge, to give information of, or stop any thing that may be sent down against the bridge, as has been directed under the head of 'Keeping Bridges in order.'

"Search for the forks of the streams that join the principal one on your side of it, and place your bridge below their confluence; launch your boats into the lateral stream; form them into pannels of 1, 2, and 4, and then send them down the stream to the point designed for the bridge; in this way it will be constructed more safely and more rapidly. Place a party of troops to defend the bridge upon the pannel that is to be fastened to the other bank.

"In the field, place the bridges near the great roads: render their

approaches at both ends, easy and convenient, by making the ramps gentle, and consolidating the ground. Take care to provide two bridges, neither too close to each other, nor too distant, (about 100 yards is a good interval.)

In sieges, bridges are made to establish a communication between the quarters of the army, and between the different points of attack. There must be at least two, one for passing in one direction, the other for returning. Endeavour to construct your bridges above the fortress; this will prevent their being insulted by the besieged, who might take advantage of the current to attempt their destruction, by sending down upon them heavy logs, and boats loaded with stones or with fireworks, &c. If the bridges must be placed below the fortress, drive a row of piles above them, to arrest these attempts of the enemy.

"Having chosen the place for your bridge, seek for the nearest fords both above and below it: use the latter on every possible occasion, particularly for the passage of cattle. Reconnoitre these fords closely, by sounding from bank to bank, and observing the nature of the bottom, so as to be sure of its solidity. Mark the way to them by posts set at the entrance and exit of them, and even place them in the river, to show their direction, their breadth, and their bends. Enlighten these objects at night, by rampart lanthorns, or if their light is so strong as to be of advantage to the enemy, or to frighten horses, use lighted matches. The fords above the bridge ought to be at a certain distance beyond the anchors, on account of the accidents that these anchors and their hawsers may cause to those who pass the ford, and which may, in the end, injure the bridge itself. If cattle must be permitted to pass through these upper fords, they must not be allowed to enter them in great numbers at a time, because they will then crowd together, strive against the current, and being carried away by it, will come down upon the bridge, and derange it.

In arriving in a country, all the boats that are upon the rivers are seized, either to serve for the construction of bridges, or for the transport of provisions, ammunition, &c.

At the ends of a permanent bridge, works are constructed to defend it against the enterprises of the enemy; these are called a *Tête de Pont.* (See *Field Fortification*, vol. 2.)

OF BRIDGE EQUIPAGE.

EQUIPAGE OF BRIDGES OF BOATS.

In order to compose this equipage, the number of boats must be regulated by the greatest breadth of the streams that are to be crossed; and often in such a way as to make two bridges at a time, particularly where they are permanently established upon a line of operations.

From the following equipage, that contains all the articles necessary for a permanent bridge of 60 boats; those required for one of light boats, (of the advanced guard,) may be easily estimated. The latter ought to be easy to transport.

I have to observe here, that in the following equipage, like all others that I give in this work, I point out those articles that will be needed; it is, then, the duty of the officer, to regulate his stores in relation to the resources offered by the seat of war, and to carry but a small quantity of those articles that can readily be procured there.

	Numbers.	Horses.
Boats,	60	
Yawls,	6	
Haquets for the boats, (6 spare ones,) 8 horses each,*	66	504
Yawl Haquets, (one spare one,)	7	40
Carts for the planks and beams,†	172	688
Ammunition waggons, for the rest of the equipment,	8	32
do. to carry the engines,	2	8
do. for small stores and pioneers tools,	2	8
do. for spare wheels, iron and wood work,	5	20
Park Caissons for the remaining small stores and edged tools,	2	8
Travelling Forges,	2	12
Add 100 led horses,		100
Total, carriages and horses,	266	1420

* For light boats, the haquets require only 6 horses, the spare haquets carry beams or planks, and need no more than 4 horses.

† The large boats are so heavy, that their equipment (beams, planks, &c.) cannot be carried with them; their haquets carry only the oars, hooks, cinquenelles, mooring ropes, and hawsers.

ARTICLES BELONGING TO BRIDGES.

Equipments.

Beams, (7 to each pannel, but 11 are allowed to each boat, for replacing others, for the piers, &c.) .	660
Planks, ($19\frac{1}{2}$ for each pannel, but 22 are allowed for each boat,)*	1320
Beams, for the draw, ...	6
Oars for the boats and skiffs, (including spare ones,)†	180
Poles with forked ends and hooks, . .	100
Clamps, 4 with 2 faces, and 14 flat ones to each boat, 20 to each pier, ...	1600
Large scoops for baling the boats, . .	60
Small do . . .	15
Iron Collars, (*Prussian*) for connecting the draw to the bridge, ...	6
Grapnels, ...	6
Anchors, $\frac{1}{3}$ of which are small ones, . .	50
Buckets, ...	30
Caulking plates, (of different sizes,) . .	10,000

The weight of these articles will be about 272,000 lbs.

Cordage.

Hawsers, ...	60
Mooring ropes, ...	360
Lashing ropes, ...	360

If cinquenelles are used, there must be 10; they are carried upon the haquets along with the other cordage.

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* For bridges of light boats, no more than 14 are wanted for each pannel, so that 16 for each boat will suffice, for the service and spare ones; there are no more than 6 beams to each pannel, so that 8 to each boat will answer for every emergency.

† If this bridge is to be transported by water, a mast must be allowed for every four boats, and long oars, poles, and hooks These will demand an augmentation of about 8 carriages to transport them, when they are again landed.

If tow lines, for haling the boats, are carried along, 30 large ones, and 30 small ones, must be added, and 360 shoulder straps, with their drag ropes.

Engines.

Handspikes,	60
Stakes bound and shod with iron,	24
Iron sledges,	4
Wooden mallets,	12
Rollers, (10 feet long, and 6 inches in diameter,)	8
Pile drivers,	2
Portable gins,	2
Jacks,	10
Screws, (of which one third are large, and as many middle sized and small,)	12

The weight of these is about 3,500 pounds.

*Small Stores.**

Lead lines, (10 fathoms long,)	4
Dark and common lanthorns,	24
Slow match, barrels of it,	1
Iron kettles to boil the tar in, and twice as many iron ladles,	2
Pitch,	300 lbs.
Tar in barrels,	1000 lbs.
Oil to mix with the tar,	300 lbs.
Brushes for paying the boats with tar,	12
Oak moss for caulking, (sacks,)	15
Flambeaux of white pitch,	100

The weight of these will be about 3,000 lbs.

* Of these articles, there are some, such as tar, pitch, oil, oak moss, which need not be provided in as great quantities, if they can be procured in the country that is to be overrun; charcoal must be provided for the forges, if it is thought that it cannot be found. This will add 2 or 3 waggons to the equipage.

Pioneers and Edged Tools.

Pickaxes, spades, and shovels, about 40 of each sort,	120
Rock-pickaxes, axes, and bill hooks, about 20 of each,	60

The weight of these will be about 800 lbs.

Spare Articles.

Haquet wheels, ...	7
Forge and waggon wheels, . . .	10
Limber wheels, ...	10
Axle trees for the different sorts of carriages, .	12

To these must be added fellies, spokes, poles, perches, swing-trees, and spare iron pieces, proportioned to the good or bad condition of the carriages. We suppose 600 lbs.

The whole weight will be 8000 lbs.

The weight to be carried by the carts, waggons, and park caissons, will be, according to the above estimate, 286,000 lbs, this will be about 1500 lbs. each, if there are 191 of them, as mentioned under the head of the equipage.

EQUIPAGE OF A TRESTLE BRIDGE.

The base for the formation of this equipage may be for a bridge of 120 feet in length. Nothing is usually carried along except the cordage, the iron, the capstans, the hooks, the mallets, the pioneers tools, and those used in the construction of the trestles, and for getting out wood for the planks and beams: one trestle is allowed to every 10 feet to be crossed, and 18 clamps.

EQUIPAGE OF A BRIDGE OF RAFTS.

For this the ropes, anchors, clamps, pioneers and edged tools, need alone be carried, with the wood for the platform, if there are to be intervals between the rafts, and there is no chance of procuring it by the demolition of houses, or in any other manner.

OF THE ARTILLERY OF AN ARMY.

In order to calculate and organize the artillery of an army, it is necessary to know before hand the composition and division of the latter.

The composition of an army depends on the nature of the country where it is to act, and of the troops it is to fight, and on the sort of war it must carry on.

For the convenience of marching and displaying, and of finding subsistence, a very large army is divided into several corps that march and encamp in different directions, but on a day of battle proceed to the points assigned to them by the commander in chief, to take a part in a general order of battle. The commanders of these corps act according to circumstances, and do what lies in their power to contribute to gain the battle.

The command of an army ought to be confided to a single chief, in order to secure unity of action; but as he can neither be every where present, nor even see all that takes place when the field of battle occupies several leagues; as he cannot receive intelligence in time to remedy accidents and check those movements of the enemy that take place during the action: he can do no more than order the general disposition, and must rely upon his generals for the execution of the several movements. Thus success does not depend upon his genius alone, but also upon the intelligence with which his orders are executed: it is evident, that slowness in the march and movements of one of the great corps of an army, indecision in its commander, and a want of the *coup d'œil* of conceptions, may render ineffectual the most perfect general combinations.

As a commander in chief cannot enter into the detail of all the

movements, he has a chief of the staff, or *Major General* of the army; the latter has officers under him, whose business it is to reconnoitre the country, to point out the line of march to be followed, to transmit orders to the commanders of corps, and the chiefs of the different administrative branches.*

Each great corps of the army and division has also staff officers, to whom are committed all the military details; the reconnoitring of roads, rivers, woods, positions, &c.; we therefore see, that the officers of the staff must be skilled in the art of war.

Of the Corps of an Army and Divisions.

A great corps is divided into lesser parts, called divisions, for the purpose of facilitating its movements and the execution of orders; each of these is divided into brigades, the brigades into regiments, and regiments into battalions.

The Division being the unit of the force of an army, it is necessary to examine what is its extent and composition. Its force is such that its commander may see at a single glance, its whole front in battle, and the movements of the line opposed to it, regulate his dispositions in consequence, and seize on the proper moment to fall upon some particular point: it is composed of from 7 to 10,000 infantry, formed usually into two brigades, (4 or 6 regiments;) of about 400 light cavalry, to act as scouts, bring intelligence of the enemy's movements, pursue fugitives, &c.; and of the artillery, of which we shall presently speak. If the divisions were weak, it would cause a useless augmentation of their number, and would complicate the manœuvres.

A Great Corps of an army is usually composed of 3 divisions of infantry; and a reserve, of at least a brigade, 4 regiments of cavalry, and batteries of artillery, to be carried wherever it becomes necessary during a battle; besides pontoneers to construct and repair

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* The service of these is committed to an intendant general; and at the head of each great department, (provisions, hospitals, military chest,) there is a commissary in chief, who has assistants that are attached to the divisions.

bridges. The force of a Great Corps is then from 20,000 to 40,000 men; its front must be of such an extent, that its General may pass in a short space of time from one extreme of it to another.

A Grand Army, is the union of several great corps. Thus an army of 100,000 men may be composed of 3 corps of about 26,000 each; of a reserve of 22,000 men in addition, of which one third is cavalry; and several batteries of artillery.

The Cavalry is usually about the sixth part of the army: this proportion varies according to the nature of the country where it is to act, that may be either plain or mountainous, open or woody. It is formed into brigades of two regiments, and divisions of two brigades. Besides the cavalry attached to the great corps, and to the reserve of the army, there are bodies of one or more brigades to act separately.

QUANTITY AND DISTRIBUTION OF THE ARTILLERY.

The quantity of the artillery of an army is in the inverse ratio of the quality of the troops: it is evident that the less they are inured to war, or skilled in manœuvres, the more artillery they will require to support and protect them; to prevent the enemy from taking advantage of his adroitness in manœuvring; to delay his movements, to overwhelm and intimidate him, before he can reach you. In such cases artillery becomes the principal arm.

The object of artillery ought to be, first, to protect the troops in displaying; and secondly, to oppose and combat the artillery of the enemy, to destroy, and make gaps in the solid mass of his troops: and not to spread its fire uniformly over the whole line. It ought therefore to be divided, into batteries of division, that constantly remain with the divisions of troops, march, encamp, and fight with them; batteries of reserve to march upon those points, where it is required to meet the movements of the enemy, and support those made in order to strike a decisive blow; magazine parks, of which one must accompany the march of each great corps, to supply the ammunition expended by the troops and the batteries; and a great park for the supply of all the rest.

Minimum of the Artillery.

A great corps of good troops, formed of three divisions, and a reserve, will have,

With its advanced guard a battery of horse artillery,		6 pieces.
To each division of infantry, a battery of foot artillery, marching with the first brigade, to sustain or commence an attack, until the other batteries arrive, which makes for three divisions, - -		18 pieces.
Reserve.	1*st. Division*, two batteries of foot artillery, at least, marching in the rear of the three divisions of infantry, -	12 pieces.
do.	2*d. Division*, a battery of horse artillery marching at the head of the reserve,	6 pieces.
	2 Batteries of 12 pounders served by foot artillery, and marching in the rear of the reserve, - -	12 pieces.

This corps of an army, of 26,000 men, supposed to be warlike and well drilled, will be provided with 9 batteries, or - - - - - 54 pieces.

If two three pounders be added to march with the park of stores, to defend it, in case of emergency, against the parties of the enemy, the total will be, 56 pieces.

An army of 100,000 men, organized as we have described, ought to have for its three corps, including 6 three pounders for the parks, - - 168 pieces.

For its great reserve.	Three batteries of horse artillery, -	18 do.
	Three do. of foot, do. (6 pound.)	18 do.
	Four do. of do. do. (12 pound.)	24 do.

The grand total for such an army will then be 228 pieces.

Or about $2\frac{1}{4}$ pieces to each 1,000 men, or 9 to every 4,000.

If this army has divisions of cavalry formed into separate corps, one or two batteries of horse artillery are added for each division.

If one of the corps is to act separately as a small army, the number of its batteries of reserve must be augmented. In this country, one of these corps may be considered as an army of itself; the divisions would be then its corps.

This proportion of $2\frac{1}{4}$ pieces to every thousand men may be considered as the basis of the organization of the artillery of an army composed of good troops; at the present day, it is usual to allow 3 pieces to every thousand men.

It may be remarked that this mode of reckoning so many pieces to each thousand men, is not accurate, for if each division of the infantry of the army were 2,000 men stronger, I would not add any artillery, except 6 pieces to the first division of the reserves.

For an army of 200,000 men, the artillery need not be double that of an army of 100,000: that of the grand reserve would be only augmented with 3 or 4 batteries.

Maximum of the Artillery.

With undisciplined and ill drilled troops, the allowance may be:

Twelve pieces to each division of infantry; 36 to the first division of the reserve of each corps; 48 pieces to the second division, being two batteries of horse artillery, 4 of foot, 6 pounders, and 2 of foot, 12 pounders, which would make in all 128 pieces to each great corps. 96 pieces to the great reserve, of which 4 batteries are of horse artillery, 6 of foot, serving 6 pounders, and 6 serving 12 pounders. The whole of the ordnance of an army of 100,000 men, organized into 3 divisions and a reserve, will then be 480 pieces.

This is nearly 5 pieces to each thousand men; which is the maximum that can reasonably be allowed to an army, to prevent it from becoming too heavy, and from being embarrassed in its marches, and in procuring stores and provisions.

Observations.

Guns ought not to be attached to the battalions, for in that case, they must not be heavier than three pounders, in order to avoid the inconveniences which would arise from too great a weight; this caliber is very inferior to that of the division batteries, with which

they would be in line; they must be managed by the battalion troops, on account of the scarcity of good matrosses, and will, therefore, be ill served, and ill commanded; besides, they are dispersed along a line of battle, and are, therefore, of little value, and rather embarrassing than useful.

To militia battalions, however, one or two pieces may be attached, to inspire them with confidence, and to support them while forming in line of battle; the rest of their artillery must be formed into batteries of division, and of reserve.

Cannon ought to be attached to a park of stores and provisions to protect it from the parties of the enemy. I propose the three pounder for this service, because it is heavy enough for the purpose, and because it may be employed in case of need, with troops sent on a flying expedition. In expeditions of this sort, cannon is often necessary to throw down a barrier, or other obstacle, to astonish the enemy, and intimidate him, when first attacked; no other than light calibers can be employed for such purposes. One half of these three pounders may be mountain pieces, with thill carriages, and without limbers, for they are lighter, and move more easily upon bad roads. I allow no guns to the great park, because it will always have with it spare pieces, that may be employed to defend it.

It is sometimes necessary to have heavy guns to batter castles, the old walls of towns, (and in this country, block-houses;) 12 pounders will not make breaches in them; so that, if it is found that they will be needed, 2 or 3 short 24 or 18 pounders must accompany the park.

CALIBERS THAT COMPOSE THE BATTERIES.

Each battery is composed of 2 howitzers and 4 guns, that are 6 pounders, in an ordinary one, and 12 pounders in a heavy battery of reserve. Howitzers are sometimes united into batteries, to attack redoubts and villages, and fire upon masses of cavalry, but this is only for the moment, and their habitual place must be in mixed batteries. On this footing the 56 pieces we have spoken of above, will be composed of 18 howitzers, 28 six pounders, 8 twelve pounders, and 2 three pounders for the park.

DISPOSITION OF ARTILLERY ON A MARCH.

The artillery of a great corps will be disposed as follows :

One battery, (6 pieces.) or sometimes two, with the advanced guard. A battery at the head of each divisions to support it.* At least two batteries that form the *first division* of the artillery of the reserve, march immediately in the rear of the divisions of infantry, in order to be ready to reinforce the points that are of consequence at the beginning of a battle.

Three batteries at least, that form the *second division* of the reserve, one of which is mounted, march at the head of the troops of the reserve, while the others, of the caliber of 12 pounders, march in the rear of them.

Then comes the park of the artillery stores of the corps.

The order of march for the artillery of a grand army will be the same. The batteries of the great reserve of artillery, will march in the rear of the great corps, a part of it in front, and a part in rear of the troops of the reserve. Then will come the great park, the equipage of permanent bridges, and the siege equipage, if there is one.

The light bridge equipage marches, if to be used, in front, if not, in rear of the great corps, as may be directed by the commander in chief.

A column of artillery ought, like that of other troops, to diminish its depth, when marching to the front, as much as possible ; in this way it will be able to form more rapidly in order of battle, and the columns will not be uselessly lengthened. For this reason it must be formed into column of sections, (that is to say, two pieces in front,) whenever it is possible, but particularly whenever it approaches the ground where it is to display. If the march is by

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* If the quantity of artillery is doubled, as in the second case mentioned above, there must be a battery at the head of each brigade to sustain it. Each of these pieces is accompanied with only one caisson, that must follow it every where. The rest of the equipage marches in the rear of the troops, so as not to interfere with them, and to render the batteries more moveable ; it must march in the rear of the first division of the artillery of the reserve ; for it would not be safe to place it last of all.

the flank, the lessening of the depth of the column is less important, because it is formed into line of battle by wheeling to the right or the left on the prolongation of the march.

The artillery, when thus disposed into batteries as moveable as possible, can be easily managed and carried with rapidity to any particular point where it may be needed.

MOVEMENTS.

We have already seen that the manœuvres of batteries are in conformity with those of the infantry and cavalry; that, like them, they can pass readily from the order of march to the order of battle or battery, by a wheel to the right or left, if marching by a flank, or by displaying to the front, if the march is in that direction; and that they can, in like manner, execute changes of front and formations into column.

When batteries manœuvre with troops, they ought to take care not to impede their movements, and to reach a new position in order to protect them as soon as possible.

When there are battalion guns, they follow the movements of the battalion to which they are attached. In order of battle they are placed in front of the intervals of the battalions; in column, they are posted in front to protect it.

When a column of several battalions marches by platoons in an open country, and is exposed to be harassed by cavalry, the pieces march upon the flank of the column a little in front of the intervals between the battalions, the caisson in their rear, and closing these intervals. In a square of only one battalion, the two pieces are placed at two angles diagonally opposite to each other, in order to be able to fire in front of every face.

POSITION IN BATTLE.

Artillery cannot produce a great effect except by a quantity of projectiles thrown into a very small space. Its object is not to strike a few men and dismount a few pieces of cannon, scattered here and there along the enemy's line, but to destroy masses of troops, to make large gaps, and terrify by a great scene of car-

nage ; it is only by uniting the fire of a great number of pieces that such an object can be attained.

The same quantity of artillery whose fires are scattered over a great space, may disable even more men, more horses, and more guns ; but it produces less impression upon the mind of the soldier. The whole line of the enemy, battered in nearly an equal proportion, is not any where pushed so vigorously as to be terrified, or as to open a road for columns of attack ; a great part of the artillery, then, must be kept in reserve to strike a decisive blow, to overthrow the points of the enemy's line that are to be pierced, and to arrest his columns of attack that may have gained advantages upon some particular point.

I shall now proceed to lay down principles drawn from the sayings of the most distinguished officers of artillery, and from actions I have myself witnessed.

In order to choose positions,

The troops to be supported, and the object to be fulfilled, should be known.

The ground must be viewed, in order to see if it will allow the artillery to advance, to examine the means of retreating, and the extent of the fire. The position is not good if the enemy can manœuvre near it under cover, and it is a very great fault if infantry can approach within musket shot under favour of some shelter.

A position, whose command is 30 or 40 yards in 600, and 16 in 200, is more advantageous than one more elevated : the fire is not so plunging, and the enemy's danger does not diminish as he approaches.

The positions that are occupied must be extensive, for fear of the enemy's diagonal fire at a favourable angle ; it is evident that the more the pieces are crowded, the more dangerous oblique strokes are. Those positions are to be preferred whence, all other things being equal, the enemy can be longest battered.

Ground that is marshy, stony, or intersected with water, must be avoided.

It must be endeavoured to cover the front, and more particularly the flanks, if they are exposed, by taking advantage of the accidents of the ground.*

Batteries in front of your own troops, or upon trifling elevations behind them, are to be avoided; in either of these cases the enemy will have two objects that may be battered at a time, the battery and the troops; and in the first the manœuvres are impeded. When no other position can be taken, the troops must be doubled so as to leave intervals for the action of the artillery.

Batteries should be so placed, that the ball in its trajectory may strike the greatest number of enemies; they should, in consequence, batter a line on its flank or diagonally, as much as is possible without their being exposed in the same way, which they must not be, unless they can certainly produce a great effect before they are silenced; neither must they venture beyond the protection of the troops, unless it is necessary to risk or even sacrifice them to the safety of the army, or when a decisive blow is to be struck. On the same principle, a column must be battered directly in front, or if diagonally, at a very small angle of obliquity.

When batteries are disposed opposite to a line of troops, they must be so aimed that the shot of the one strikes opposite to the other. These batteries, which are called cross, besides traversing the position of the enemy, and the ground he must pass over to the attack, in every direction, defend each other mutually.

If a defensive position is occupied, the pieces of large caliber ought to be placed, in preference, where they can see the enemy

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* In battle, the cannon are not covered by an epaulment, for they do not remain constantly in the same position: if, however, they are in a position that they are likely to hold during the whole of an action, they may be covered, if time will permit, with an epaulment 2 1-2 feet in height; I have seen this practised in the field more than once.

at the greatest distance and batter the points, whence he files out to form the heads of his columns that threaten an attack, and the ground in front of the weakest points of your own line.

The troops of the enemy that are nearest to the point attacked, must be battered when these points can no longer be fired upon.

The Horse Artillery ought to be reserved for movements that require to be quickly performed. It can follow cavalry, and support it by throwing disorder into the enemy's ranks, whether it is charging or charged. It also enables cannon to be thrown with rapidity upon a point that is growing weak, a favourable position to be promptly taken, or a bold attack to be made.

Artillery must not be abandoned too soon; nor must its loss be feared when there is no reason. *Guibert* says: troops must not acquire a habit of abandoning their guns on slight pretences; the matrosses ought to expose themselves, when their pieces are producing decisive and deadly effects, and must not abandon them until the enemy is almost within the battery; for the last discharges are much the most terrible. In a word, there are circumstances, when the gun must be exposed in order that it may injure the enemy more, and for a greater length of time, when it must be allowed to be taken, because it would either cost too much blood, or too much valuable time to defend it, and others where it must, at all hazards, be preserved.

It is evident that batteries must manœuvre and change their position according to circumstances; either to march with the troops, or to preserve the advantage of firing upon the enemy; to advance to occupy a better position; to unite their fire upon decisive points; to march in battery of attack; or to advance against another point of the enemy's line after having completely destroyed the first. In this way, at the battle of the *Moscowa*, the batteries of reserve, (particularly the howitzers that were united,) marched at the beginning of the action against the redoubts that covered a part of the Russian line, overwhelmed them with projectiles, and facilitated their capture; these batteries then pro-

ceeded towards the left, and destroyed the enemy who was advancing in mass. At the battle of Wagram 60 pieces of cannon of the imperial guard moved upon a trot, in columns of divisions, against the Austrian army that was beginning to make an impression on the left of the French. Having reached it, they displayed in the manner of squadrons of cavalry, stopped its progress, and pursued its retreat. Almost all the battles won by the Emperor Napoleon offer examples of great movements of the batteries of reserve.

The application of the preceding principles to the ground, and to circumstances, depends upon the military talent and the *coup d'œil* of the chief, the discipline and mobility of the batteries.

OF SERVING ARTILLERY.

Great attention must be paid to the aim when the ranges are long, and the fire may be quickened as they decrease, because the aim may then be taken with more certainty. When we fire with precipitation at unknown ranges, we do but little harm to the enemy, and thereby render him audacious, consume ammunition uselessly, and are in want of it at the very moment the fire ought to increase in vivacity.

The effect of field pieces may begin to be fairly reckoned upon at a distance of about 1200 yards, but it is still by no means certain.

In firing against troops advancing in deep order, the gun must be pointed low ; because if the ground is at all favourable, the balls will rebound, and the execution of the fire be more certain ; fire low also with case shot if the ground is dry and uniform, in order to obtain ricochets ; when the ground is wet, unequal, rising or falling suddenly, case shot must be used at less distances, than in the contrary case, because the advantage of the ricochet cannot be obtained.

The ammunition must generally be economized, but may be lavished at important moments ; for instance, when the enemy

charges. (It takes infantry 3 minutes to pass over 200 yards, in accelerated time, and cavalry gallops over the same space in half a minute.)

A cannonade that has no other object than to make a noise cannot be tolerated, except for the purpose of raising the courage of ill-disciplined troops, and of exciting the soldier in order to seize a favourable moment to lead him to charge the enemy.

It will not do to engage artillery against artillery, unless the troops of the enemy are under cover, and his guns exposed; or unless your troops suffer more from his cannon than his do from yours; and it is therefore necessary to silence the enemy's artillery in order to protect the soldiers who are exposed to it.

When your batteries are about to attack those of the enemy, it is better to direct the fire of several pieces upon a single one, in order to destroy it, and then pass to another, than to embrace the whole extent of the enemy's battery with your fire, as is directed by some military men. In attempting in this way, to destroy the whole at one time, nothing is destroyed, all the pieces perhaps suffer, but not enough to silence them; their number is not diminished; nor are the men intimidated.

Cannonading at night answers no other purpose than to excite the spirits of the soldier, or to make a feint of an attack. The fire is too uncertain in the dark, unless every thing has been prepared for it during the day, and the precaution of giving a proper direction to the pieces has been taken. It is then a good plan to have some phosphorus to trace the line of sight with.

The pieces ought not to be dragged by the prolonge until they arrive near the line of battle, and just be forethey come within reach of the enemy's artillery.

In all changes of position, the pieces will move with the prolonge, unless the distance to the new position is too great, or the ground unfavourable, in such cases, the horses would be fatigued, and time lost instead of being gained.

Defence and Attack of Intrenchments.

In the defence of intrenchments, the artillery ought to be placed in relation to the probable attacks of the enemy, and especially in such a way as to take the columns of attack in flank, and batter them even after they reach the ditch ; it must not impede the action of the infantry in the defence of the points attacked, and should be exposed as little as possible to the artillery of the enemy. Thus, in the defence of a bastioned line, the artillery should be placed upon the flanks and the curtain, in order to have a complete action on the counterscarp, and the ditches of the bastion faces ; these re-entering batteries will first batter the ground in their front, and will be effectually protected by the cross fire of the bastions ; that will be, in their turn, defended by the fire of the cannon that crosses upon their capitals, which are the usual directions of the columns of attack ; they will also bear upon the enemy even after he enters the ditch. It will also be a good plan to have a piece pointed in the direction of the capital, to open its fire when the enemy is within reach of grape shot.

When a lunette or a redan is raised on some point to protect the artillery posted upon it, the work must be treated, as much as possible, as if it were a reduct for the defenders of the pieces.

When a position is defended by several lines of detached works, the greatest part of the artillery, and the heaviest pieces, must be placed in the works that are in the rear, when they command those in front of them so much as not to be impeded by them in their fire ; but when the works of the first line command the country, and those in the rear can only protect the first by flanking their faces and ditches, they are no more than their reducts, and it becomes necessary to place the heaviest guns in the works of the first line.

In the attack, the artillery ought to be placed so as to enfilade the faces and the flanks of the works whose fires bear upon the attacking troops, and to destroy the troops and artillery of the enemy ; it will also batter the works directly, in order to open breaches. I suppose, (fig. 31. plan 2. vol. 2d.) that the lunettes

a, *e*, *d*, are to be attacked ; batteries will first be placed upon the prolongations of the faces of the lunette *e*, of the right face of the lunette *a*, and the left face of the lunette *d*, and also upon the prolongation of the flanks ; these batteries will then fire upon every thing behind their parapets that can impede the march of attacking columns, and will endeavour to effect a breach in the salient angles. The artillery is first placed without the range of grape-shot from the works that are attacked, and is then brought as near as 300 yards, to batter the works more successfully and warmly at the moment of assault.

ON THE DUTIES OF COMMANDING OFFICERS OF ARTILLERY.

The commandant of the artillery of an army ought to know at least the outline of the plan of the campaign, in order to form the scheme of his equipage ; make his dispositions for securing the removal of the stock of ammunition ; examine into the nature and resources of the country that is to be the seat of war ; and make many indispensable arrangements that would be, at a later period, either impossible, or of difficult execution.

He ought, upon a day of battle, to know a part of the designs of the general, in order to assemble his batteries of reserve, in the position in rear of the line of battle most proper for their ulterior operations ; he should pass over the ground both before and after the beginning of the combat, to ascertain how the artillery may be employed to advantage, and what positions are to be occupied in preference.

He ought especially to superintend the batteries of reserve, because they are more immediately under his own command, (those attached to divisions of infantry and cavalry being at the disposition of the chiefs of these arms.) With these batteries of reserve he will have it in his power to contribute powerfully to the success of the battle, and to show himself in the field as a general, after having finished his administrative duties, in providing for replacing the ammunition, gun-carriages, implements, &c. He ought also to watch the march of his park of stores carefully, and take every precaution that the service is not interrupted.

Commandants of batteries and parks ought, when they first take charge of their material, to ascertain that it is in good order, and

complete ; in the course of their service, they must examine personally into the state of the ammunition, that should be frequently aired, by opening the caissons as often as the weather will permit; see that the condition of the implements, prolonges, and gun-carriages is good, and have them repaired in due season. It often happens that very trifling injuries produce great disasters; for instance, if a pole splits it will not be long before it breaks, which may oblige the column to halt, and will, if it is in a narrow hollow way, prevent it from arriving in time, or cause the loss of many men when it is in retreat.

We must recollect here, that in a battery each piece is followed by only one caisson, the others, with the forge store-waggon and spare gun-carriage, form a small park, (that is likewise called the reserve of the battery ;) it follows the battery when it is not between the troops, or is not united into a mass with other batteries. In the first of these cases it is usually placed in the rear of the troops of the division, of which it makes a part; in the second case, all these small parks follow in the train of the batteries that march together. (These small parks must not be thrown too far behind, because they might not then be within reach when wanted.) In battle, the small park is placed a few hundred yards in the rear of the battery, and is sheltered as much as possible by circumstances of the ground. The commander of the battery ought to take care to know its position, and detach to it a corporal, or an intelligent and trusty matross, to return a report to him as soon as it has taken its ground. This will prevent him from being compelled to seek for it during a battle, or being in want of ammunition. The non-commissioned officer who has charge of the small park, will place himself in such a way as to be able to advance or retreat freely, and must not be in the way of the march of the troops.

A commandant of a park ought to anticipate those articles that will be most needed, and take care to have a store of them provided; he ought to have a division composed of caissons, and infantry cartridges, with a full complement of horses and drivers, ready to march; he ought to send to the chief of the artillery an officer who knows the position of his park, who will receive

orders where a fresh supply for the emptied caissons is to be sent; he ought to place his park so that it can readily retreat without embarrassing the army: if he finds himself near a defile, he will leave it between him and the army.

The director of a great park ought to be constantly in motion to discover and assemble every thing that an enemy's country affords, powder, projectiles, lead, iron, carriages fit for transportation, teams, and other articles necessary in his park, which is the general magazine of artillery for the army. He ought to place his depots in proportion as he advances, and establish convoys to communicate with them.

The director of the great park of a grand army, that is acting far from the frontier of its own country, must be an officer who has great resources of mind, is active, watchful, and understands the whole detail of the material.

The general command of the bridge equipage also calls for a very active officer, who is well acquainted with that branch of duty.

The commandant of a battery ought to take the greatest care to keep his teams in good order; for upon them the rapidity of his march, and, consequently, his military reputation and usefulness, in a great measure, depends; he ought to replace his infirm and worn out horses, with others procured in the country, and not carry useless ones along with him, for they employ men who might be otherwise usefully engaged; he ought to be persuaded that whatever he does for his teams, &c. will be approved of, provided he arrives in time to fight, and in a state to manœuvre; but that he will be always in the wrong, if he arrives too late, or in a state unfit to manœuvre on the field of battle.

OF THE PASSAGE OF ARTILLERY OVER HIGH MOUNTAINS.

The following is an account of the passage of the Alps, by the French artillery, previous to the battle of Marengo.

The Austrians, at that time masters of Italy, were besieging Genoa: Napoleon had hastily formed an army at Dijon, to reconquer the country; instead of marching by Provence, to attack the Alps in front, according to the usual method, and as they expected him to do, he sets off for Switzerland, and mounts the Rhone to Mar-

tigny, (24 miles beyond the Lake of Geneva.) At this place, he changed his direction to the right, to take the Alps in reverse, and arrive unexpectedly on the rear of the Austrians; passing his army over the narrow defile of the great St. Bernard. Proper means of transportation for the artillery were wanting; there was no time to construct them, or bring them forward from the arsenals in the rear; no pioneers' work could be done, for the success of the enterprise demanded great dispatch, and that there should be no previous demonstration.

"At the village of St. Pierre, about 20 miles from the convent of St. Bernard, which is 5,100 yards above the level of the sea, the road became very narrow and steep; it, therefore, was necessary to dismount the artillery. The iron work, and the ammunition, were packed in boxes, that were carried on the backs of mules; the bodies of the caissons, emptied and separated from the cover, were carried each by 12 men; the covers, and the wheels, the limber bodies, and flasks of gun carriages, &c. by as many men as were needed for these several purposes. The guns were fixed in logs of pine wood, hollowed out to receive them, and dragged by hand. All the parts of each separate carriage were marked with the same number, and were escorted by a few matrosses and a non-commissioned officer, to prevent confusion, and see they were not injured.

"The artillery was remounted on the Italian side of Mount St. Bernard, at the village of *Estroubles*, and descended the valley of the Aost to cross the Po, near Pavia, and triumph at Marengo.

"For every 50 pieces, there was half a company of workmen at St. Pierre, to dismount the artillery, and a whole one at Estroubles, provided with travelling forges, to remount it on its carriages.

Several regiments of infantry, assisted by about 500 peasants of the mountain formed into companies, were employed in the transportation. They were paid at the rate of from 180 to 240 dollars for each gun and its caisson.

Note. It may be more expeditious to place the pieces in pine logs, and to drag them in that way, even before the snow is met with, than to put them on mountain sledges for the first part of the passage; but the solid wood in front of the lodgment of the piece ought to be left very long, in order to resist the friction of the stones for a greater length of time.

Gun-carriages and caissons may be passed over the snow by means of sledges of logs rudely squared; but when the snow is passed, these sledges are quickly worn away by the stones, and mountain sledges are then wanted.

"The caissons are, on account of their length, the most difficult to transport of all the equipage; they were, in the above described passage, emptied and carried by men: but this method is both dangerous for them and injurious to the articles themselves.

"When a caisson is carried upon a mountain sledge, it must have a wooden cushion placed beneath it, in order that it may not be worn out by striking against the earth as the sledge swings." (*Gassendi.*)

INSTRUCTIONS FOR AN ARTILLERY STOREKEEPER ON A MARCH, AND FOR ALL COMMANDANTS OF CONVOYS.

The storekeeper ought to examine personally, on the eve of his departure, all the carriages he is to command; should see that they are greased; should take care that there are a number of wheels and other spare pieces, regulated by the kinds and condition of the carriages, by the chance of providing supplies at the places he will pass, and by the time he will be upon the road; he must provide the necessary quantity of grease; furnish himself with axes, bill hooks, pioneers' tools for repairing the bad parts of the road, and with tackling for performing mechanical manœuvres.

He must give the chief storekeepers a receipt for the articles he receives from him;

Take a detailed account of the loads of the carriages;

See that they are loaded the night before that fixed for setting off, if circumstances permit; superintend the stowage, see that it is done with order, and the arrangement he has directed preserved with regard to the several articles for which he is responsible;

And ascertain that the horses are well shod, and the harness good.

Order of March. The heaviest loads are in front, for the transport of them would be much more difficult if they were in the

rear, as the first carriages would have, in some degree, injured the road.

No extraneous article ought to be loaded on the carriages, and no body should be permitted to ride upon them.

The convoy ought to march slowly, in either one file or two, according to the breadth of the road;* the carriages ought to follow each other without intervals and without halting; if any accident happens to one of them, it leaves the file to repair it, and then returns to join the rear of the convoy: if the damage is so great that this cannot be done, the storekeeper causes its load, and even the parts of the carriage, to be distributed among the other carriages; if it cannot be carried along in either of these ways, a person is left to watch it, and the horses are led to the station for the night, or the nearest place whence assistance can be procured, in order to bring it forward or place it in safety; a requisition is made for this purpose upon the artillery commandant, or the civil authority, as the case may be.

If there are any travelling forges attached to the convoy, they ought to march last, with the workmen and spare pieces, for the convenience of effecting repairs.

The convoy takes the right hand side of the road, and never crosses it except in case of necessity; the drivers must not be permitted to leave their horses. The storekeeper often passes from the van to the rear of the convoy to superintend the preservation of the carriages.

The pins are taken out of the poles, in rising and descending the steep slopes of ditches, or of narrow and deep ravines, in order to facilitate the draught and passage, and preserve the poles; the pins are replaced as soon as possible afterwards.

The wheels must be locked at the proper places, and by the proper fellie.†

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* The public convenience must always be consulted, so that room must be left for the passage of two carriages on one side of the files of the convoy.

† The locking chain ought to pass between two spokes where two of the fellies meet, so that the tire may bear upon the grouud in the middle, for if an end rested on the ground, the stones would knock out the tire nails; care must be taken that the chain is not too long, for it would, in that case, cut the spoke, that would have the whole strain to support alone.

If a steep hill is met, the convoy halts, and horses are drawn from the carriages in the rear, to double the number of horses harnessed to those that march.

If an attack is feared while on the march, the escort, that must have been provided in consequence, will be formed into three detachments; one of these will be placed in the front, one in the rear, and one at the centre. If surprises are dreaded in those places where the convoy halts for the night, military guards must be posted, the heights and defiles occupied, and patroles established.

If the distance is so great that a long halt must be made at some intermediate position, a convenient station is chosen to form a park on, while the convoy remains; this must not be in a village on any account.

Before the arrival of the convoy at its stopping place for the night, the food must be prepared, and the quarters, if it is not to encamp, as well as a favourable spot for the park; uncultivated and dry ground is best for this purpose, and it ought to be free from inundations caused by violent storms of rain, far from places where fires are made, and should have passages easy of access to and from it.

If the articles that compose the convoy are not cased up, and it is impossible to establish guards for them; a place where they will be safe must be asked for from the military commander, or the civil authority; if such a place cannot be found, a guard must be required until the time of departure; the storekeeper goes the rounds of the convoy with the officer of the guard as soon as it is parked, and delivers the charge of it to him; the same is done when about to resume the march, to see that nothing is wanting; and as this officer is responsible during the interval between their arrival and departure, the storekeeper never visits the convoy without calling upon him to accompany him

The storekeeper inspects all the carriages, once a day, when they reach their station: he directs the repair of every thing that urgently demands it; he sees if any thing has been lost or carried off; and states the amount of it to the officer of the train, for his soldiers are responsible for the carriages they drive. If any carriage cannot continue the march, he gives it in charge to the person appointed to guard it by the military or civil authority; he takes

a receipt from him, stating its situation, and gives immediate advice to the director of artillery, who has entrusted him with the convoy.

If the roads are not known, guides must be procured; if subsistence is scarce in the country, it must be laid in.

The time a convoy is to remain upon the march daily, being known from the number of leagues to be travelled, the hour of setting out is so regulated that it may reach the next station in time to distribute it properly, and to perform the necessary repairs.

In all places where military commandants reside, or artillery officers are upon duty, the storekeeper ought to report himself and the convoy he has charge of, for it is possible that they may have orders to communicate to him, respecting a change of destination; these new orders ought to be in writing.

When he reaches his final destination, he delivers over the convoy, to the person named in the order of the director who sent him, and takes a receipt for it.

If, when he returns with the empty carriages, a military commander or commissary at war, should wish to load them for some urgent purpose, he must inform the director, in writing, of this order; and take care of this new charge, which must be distributed so that no carriage has more than 1,500 pounds to bear; he must, on no account, however, deviate from the road first pointed out to him for his return.

In convoys of powder, the most minute precautions are often of the greatest importance. The places where they park ought to be far from every fire; the conductor must watch that neither the soldiers, nor other persons who approach the carriages, smoke; he must send forward a non-commissioned officer, to enter the villages that must be passed, and cause all the workshops, whence accidents are to be dreaded, to be shut, and the fires near the road to be put out. He should not enter either towns or villages, if he can pass in any other way, but must not undertake any unknown passage without reconnoitring it.

He must travel at a walk, and upon the summer roads, rather than the pavement or gravel, march in file, and put no extraneous articles on the carriages; the barrels must be packed in such a way as not to rub in jolting; the carriages are to be covered with a cloth of close texture, or even painted, in order to preserve the

powder from the rain. Gunpowder ought never to be transported without an escort.

OF THE DUTIES OF ARTILLERY STORE-KEEPERS.

Artillery store-keepers are entrusted, 1st. In arsenals and fortresses, with the care of the magazines, and their dependencies, with the arrangement and preservation of the articles they contain ; in armies, with the charge of the carriages that compose the equipage of artillery, whether in park or on the march.

2d. With keeping an account of the wear and tear of the material of artillery.

3d. With the general and detailed inventories of the different articles.

4th. With the receipts and disbursements of money.

5th. With taking articles into store, and delivering them for use.

In a Post, the storekeeper ought to have an inventory always ready to deliver to a successor, the commander of the post, or to an inspecting officer, should he arrive ; should furnish accounts of receipts and expenditures, of articles received and delivered, at stated periods ; when he delivers his charge to a successor, which is done in the presence of a commissary at war, he takes a discharge in full upon the bottom of the inventory.

In convoys, he always carries the keys, and sees that the caissons are aired in dry weather.

In park, he must have the keys constantly about his person, so as to be able to deliver instantly whatever is wanted ; must return an account after an action, of the consumption, and have it supplied, and the repairs that are wanted made. (In batteries of field artillery, the quarter-master sergeant usually performs the duty of the store-keeper.)

It may be seen, that a storekeeper ought to know, at least, the four first rules of arithmetic ; the names of the different pieces that compose artillery carriages and machines ; the use of the most essential ones ; the mode of stowing these carriages, and the articles the load should be composed of, &c. ; together with the mechanical manœuvres necessary in loading and unloading. (*Aide Memoire.*)

FIELD ARTILLERY EQUIPAGE.

An equipage of Field Artillery, (the material and personal necessary for an army,) is composed with reference to the nature of the country, and the species of war that is to be carried on: in a level and open country, 12 pounders are to be used in a pretty large proportion, along with 6 pounders and howitzers; among mountains, 3 and 6 pounders are required, and either no 12 pounders, or but very few; if a numerous cavalry is to act, there must be more horse artillery; if important positions, that interfere with the plans of the enemy, are to be occupied by intrenched camps, or temporary fortresses, artillery of large calibers is necessary; if the country has resources for the supply of stores and the repairs of the carriages, the parks need not be as considerable as in the opposite case. The bridge equipage ought also to be made up in relation to the nature of the water courses that are to be passed, and the means for executing these passages that can be found in the country.

Two and a quarter pieces to 1,000 men, with two complete sets of ammunition,* one of which marches with them, and the

* By a single set of ammunition is understood, that necessary for each gun for a great battle; this is from 150 to 180 rounds, and it rarely happens that so much is consumed; on this basis, the allowance for a 6 pounder is fixed at 2 caissons, of about 88 rounds each, that of a howitzer at 3 caissons of 50 rounds, and that of a 12 pounder at 2 1-2 caissons, of about 60 rounds each. (The two last do not fire as much as the 6 pounder.)

other is at hand to replace it instantly, is the minimum of the artillery of an army composed of good troops; and 3 pieces are usually allowed to each 1,000 men. (See what we have said under the head of Field Artillery.)

The proportion between the calibers is as follows, viz: about one half 6 pounders, from one fourth to one third howitzers, and the rest 12 pounders, in a country easy of access; the horse artillery ought to be about a fifth of the whole.

The allowance of infantry cartridges ought to be about 200 to each foot soldier, 40 of which he carries in his cartouch box, 40 are carried with the batteries or with the small parks that accompany them, and 120 partly in the great park, and partly within reach in depots in the rear.

We have already shown the number of batteries necessary in an army; we must now determine:

1st. The composition of the battery, which is the unit of the artillery force;

2d. The composition of the parks of the corps of an army from which the batteries receive supplies;

3d. The composition of the great park, which is the general magazine and arsenal of the whole artillery of the army;

4th. The composition of bridge equipage;

5th. The personal of the artillery that is necessary for all the above parts.

MATERIAL OF THE EQUIPAGE.

Of the composition of Batteries.

	Battery of 6 pounders & howitzers	Battery of 12 pounders & howitzers
12 or 6 pound guns, their gun-carriages, and limbers,	4	4
Howitzers,	2	2
Spare gun-carriages and limbers,*	1	1
Caissons of Cannon cartridges. 6 pounder,	8	
12 pounder,		10
howitzers,†	6	6
Store waggon,‡	1	1
Travelling forge,	1	1
Total number of carriages.	23	25
To harness the 12 pounders, forges, and waggons with 6 horses; and the remainder with 4; for foot artillery, it will require,	96 horses	116 horses
Adding 4 caissons of infantry cartridges to each battery of foot artillery, of the caliber of 6 pounders, to be ready to supply the first wants of the infantry, this battery will be,	27 carriages & 112 horses	
Horse artillery must put 6 horses to each gun, and to the caissons of the 1st line, which would take,	120 horses.	

* For every two batteries of 6 pounders, a spare gun-carriage is attached to the one, and a howitzer carriage to the other; it is the same in 12 pounder batteries. But when the batteries act separately, a spare gun-carriage must be allowed for each caliber.

† If there are by any chance howitzer caissons, that will contain 75 rounds, only two are used for each howitzer; in the same manner, no more than a caisson and a half is allowed to each 6 pounder, when they are of the large heavy kind that contains from 110 to 120 rounds.

‡ A waggon is sometimes provided to carry the spare pieces, and another for the harness of horses that die or become unfit for service, and the spare leathers; but a single one is quite enough: horse artillery may have two on account of the harness of the matrosses' horses; this, however, serves to encumber and embarrass it, without being actually necessary.

On the principle of the above table, as the company of the train is composed of 137 draught horses, there will remain 25, 21, or 17 additional horses, to each battery; these will supply losses, and reinforce the teams of such pieces and caissons as need it, or will draw some of the caissons of the park.

It is to be observed, that when a battery is isolated, it will want a spare gun-carriage for each of the calibers that compose it; and that a battery of horse artillery, acting by itself with the advanced guard, ought to have a caisson of infantry cartridges.

See the detail we shall give hereafter of the stores and load, of the caissons, store waggons, and forges, that compose a battery.

See also the composition of a battery of mountain guns.

Park of a Great Corps.

The park of a great corps of an army is composed of half an allowance of ammunition for its cannon, and 40 cartridges to each foot soldier, including those carried along with the batteries; of the forges, and the store waggons necessary to carry the articles for keeping the material in order. The whole of the second allowance cannot be carried with this park, without adding too much to the weight of the corps.

Grand Park.

The grand park, being the great workshop of the whole artillery of an army, must provide for renewing the supply of ammunition, and replacing the cannon, gun and other carriages that re unfit for service, and cannot be repaired in the separate parks of the corps of the army. Besides the great park, there are depots of ammunition, carriages, and the materials for repairs, in the rear, in strong places, or temporary fortresses. The latter are established when advancing into the country in order that the army may not be isolated and left without resources between it and the frontiers.

The composition of this grand park depends upon the state the carriages are in; on the resources of the country that is to be the seat of war; on the distance from the frontier towns whence sub-

sistence can be drawn; on the greater or less ease of establishing good depots, and convoys, as the army advances; and on the sort of war that it is proposed, and which the army is in a situation to carry on. Those essential articles, that are difficult to be replaced, must be provided in sufficient quantities: no more than a small quantity of spare pieces of wood, and iron, need be laid in, for these materials abound every where, and nothing is needed but workmen and tools to make them.

The following is the basis of the formation of the grand park:

Cannon, $\frac{1}{20}$th part of the number of pieces in the batteries, but there must be at least one spare cannon of each sort to every corps of the army.

Spare gun carriages, $\frac{1}{15}$th.

Caissons: the park ought to have with it the half of the second allowance of ammunition for the cannon. It may be carried partly in caissons, and partly in boxes, upon waggons; the caissons then need not be in greater number than a third of those that are with the corps of the army.

The remainder of the infantry cartridges that are furnished by the park, is partly carried in boxes upon waggons, and partly placed in the depots in the rear.

Park caissons, 4 to each company of workmen; and out of 16, 2 are loaded with workmen's tools, 8 with edge tools, 1 with the implements for making fireworks, 2 with fireworks made up, one with armourers' tools, and 2 with small stores.

Forges, 4 to each company of workmen: but as permanent forges can be either found or built in case of need, this number can generally be diminished.

The number of division waggons and carts will be in proportion to the spare pieces and supplies needed by the great park. (See the sequel of this article.)

The number of artillery workmen is to be relative to the quality of the material, and the work that must be performed to keep it in order. It is better to have a number of workmen to construct the articles as they are wanted, than to load the park with a great quantity of spare pieces, thus augmenting the number of carriages, and, in consequence, the embarrassments and difficulties of the march.

There must be a squad of artillery workmen attached to the

park of each corps of the army, besides the workmen who perform the daily repairs, and form a part of every company of artillery.

This grand park is divided into two parts: the first division, or Magazine Park, is composed of the proportion of the second allowance, the infantry cartridges, the cannon, the gun-carriages, and other spare articles for each different park.

The second division, or Park of Construction, is made use of for the great repairs, and new constructions, for preparing ammunition, &c. and ought to be provided with every thing necessary for these labours.

We shall, hereafter, see the articles that compose its stores.

Bridge Equipage.

See *Military Bridges*, of which we have previously treated.

PERSONAL OF THE FIELD EQUIPAGE.

General Staff.

1 Lieut. General, commanding the artillery in chief.
1 Brigadier General, or Colonel, chief of the staff.
1 Lieut. Colonel, 2d of the staff.
2 Majors, (or more, if the army has several corps.)
4 Captain Lieutenants, do.
2 Officers of the Train.
2 Artillery Storekeepers, (1 cashier, and 1 to make up returns.)

To each corps of the Army.

1 General, commanding the artillery.
1 Lieut. Colonel, chief of the staff.
2 Captain Lieutenants.
1 Colonel, commanding the batteries of reserve.
1 Major, commanding the first division of the reserve.*

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* If the artillery were very numerous, say if there were 10 or 12 batteries of reserve instead of 5 or 6, there must be two Majors more. In general, there should be a major to every 2 or 3 batteries.

1 Adjutant, or Captain Lieutenant, who accompanies the colonel.
1 Artillery Storekeeper.
1 Company of Artillery, and 1 of the train to each battery.

With the park.
- 1 Lieutenant Colonel, or Major, Director.
- 2 Captain Lieutenants.
- 2 Artillery Storekeepers.
- 1 Master Artificer.
- 1 Veterinary Surgeon.
- 1 Squad of Workmen, the necessary number of the train for draught, about half a company of artillery as a guard, or a detachment of infantry. The workmen may serve the 3 pounders that accompany the park.

Great Reserve of Batteries.

1 Colonel commanding.*
1 Major commanding the batteries of horse artillery.
1 do. do. do. of foot artillery, 6 pounders.
1 do. do. do. do. 12 pounders.
2 Adjutants, or Captain Lieutenants, to accompany the Colonel.
1 Artillery Store-keeper.
A company of Artillery and one of Train to each battery.

This great reserve of batteries has a park like that of one of the corps of the army; however, as its habitual position is in the centre of the army, where the first division of the grand park follows it, its park need not be as great as that of one of the corps.

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* I only allow one colonel, although there are at least 60 pieces of cannon, because these batteries are under the eye of the general in chief of the artillery, who will act with and direct them. However, when this reserve is as large as 80 or 100 pieces, there must be a general and several colonels more.

Grand Park.

	1st division.	2d division.
1 Colonel, Director in Chief, (with the park of construction,)*		1
1 Lt. Colonel, 1st Assistant do. (commanding the magazine park,)	1	
1 do. 2d do. (commanding the park of construction,) . . .		1
2 Majors, ...	1	1
8 Captain Lieutenants, for the several services, .	3	5
1 Major of the Train to command the draught horses, requisitions, &c. . . .		1
2 Officers of the Train, Captains or Lieutenants .		2
1 Store-keeper general, . . .		1
2 Principal Store-keepers, . . .	1	1
8 Store-keepers, ...	4	4
1 Cashier, (store-keeper,) . . .		1
2 Master Artificers, ...	1	1
2 Veterinary Surgeons, . . .	1	1

Several companies of workmen, according to the condition and number of the carriages of the whole artillery, the distance and nature of the seat of war. It is better to augment their number, and diminish that of the spare articles.

The train necessary to draw the carriages : a part is sometimes drawn by horses obtained in the country by requisitions ; the convoys, at least, from the frontiers to the several depots, are brought forward in this way ; (this depends on the nature of the country and of the war ;) several companies of artillery for labour, and the ordinary guard, besides some battalions of infantry, detailed as an escort, when circumstances require it.

Equipage of a Bridge of Boats.

1 Lieutenant Colonel or Major, Director.†

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* A general commands the great park, if it is very considerable, and if the army is very large, and acting far from the frontiers.

† A colonel, or even a general, is placed at the head of this service, if its im-

3 Captain Lieutenants.

2 Artillery Store-keepers.

A company of pontoneers to each bridge of boats, and the train necessary to drive the equipage. (See *Bridge Equipage.*)

Mountain Park.

A mountain park, when it is necessary, becomes part of the great park of a corps of the army; it is therefore included under that command.

Depots.

In the depots, in rear of the army, there are companies and squads of artillery, directed by the officers who command them. If these detachments leave them without being relieved, the director will send thither a captain, a lieutenant, or a store-keeper.

In more important depots, a superior officer is posted.

Park for a Siege.
(See *Siege Equipage*, 2d volume.)

EQUIPAGE OF MOUNTAIN ARTILLERY.

An equipage of mountain artillery must be established in conformity with the plans of the general of the army, and in relation to the nature of the mountains themselves; observing, however, that the quantity of the stores must increase or diminish with the distance of the grand park of the army, and other resources. It will be easy to calculate the equipage that may be needed, from the following table of the composition of a section of two pieces of the several different calibers.

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portance demands it. If, for example, there are several permanent bridges of boats, &c. to establish upon the communications of the army. The number of other officers is also augmented in consequence.

Sections of 2 pieces of the calibers of	12 pr.	6 pr.	3 pr.	hwtzr
Pieces on carriages, (and limbers for the calibers that need it,) - - - -	2	2	2	2
Spare gun-carriages, - - - -	1	1	1	1
Frames (*Chevrettes*) to support the front of the gun-carriages, or pairs of large wheels, -		3	3	3
Swinging gun-carriages, - - - -	2			
Jacks with their levers,* - - -	2			
Ammunition boxes,† - - - -	60	32	16	48
Boxes of implements,‡ - - - -	2	2	2	2
Rounds per section, (of which one fourth is grape for guns, and $\frac{1}{8}$ for howitzers,) -	300	320	320	288
Folding levers, - - - - -		3		3
Carrying handspikes, - - - -		24		24
Crooked handspikes, - - - -	3	3		3
Straight or manœuvring handspikes, -	12	8	8	4
Block slings, - - - - - -		8	6	8
Pointing coins, half of which are hooks, -	6	6		6
Draught mules { for the gun-carriage, -	12	14		14
Draught mules { for the sledge, - -	20			
Draught mules { supernumerary, - -	4	2		2
Bat mules { for guns and gun-carriages,			6	
Bat mules { for the boxes, - -	36	20	10	30
Bat mules { supernumeraries, - -	6	4	6	4
Total of the mules of a section,	78	40	22	50

Tubes, slow-match, port fires, in proportion to the number of rounds, as in field pieces.

Ammunition pouches, 3 or 4 to each piece; tube pouches, port fire boxes, 3 to each section; thumb stalls, port fire stocks, linstocks, 4 to each section.

Priming wires, spunges, and rammers, 3 to each piece; worm, bucket, single prolonge, 1 to each piece.

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* To pass the piece from the sledge to the carriage.

† Each box contains no more than 5, 10, 20, or 6 rounds, according to the caliber, so that a mule may carry two of them, and they may be easily loaded and unloaded

‡ These boxes contain all the stores and implements, from the tubes to the spunge, and also a little box that has in it a hammer, a pair of pincers, two bill hooks, and nails.

Six feet of prolonge rope, and a picket to every two mules, 2 mallets per piece.

Sand-bags, 2 to each piece ; pioneers' tools, 10 to each piece, (4 pickaxes, 2 rock pickaxes, 2 spades, and 2 shovels.) These tools should be packed in a slight box, whose sides are made of bars of about the same length as the handles, and laid along it in such a way that they may be easily drawn out by their blades, which rest on grooves upon one of its ends.

Stores for six Pieces.

1 Forge, (portable or mountain.)

1 box of smith's tools.

2 boxes of grease.

2 boxes of prepared fire-works, containing four empty powder bags, 80 feet of slow match, tubes, 12 signal rockets, 1 rampart lanthorn, and 10 tarred tourteaux, to each piece ; 1 loaded pétard to 6 pieces ; 10 pounds of fire stone to each howitzer, and one fuse drawer.

Infantry cartridges in proportion to the number of foot soldiers.

Spare Articles.

Swing trees, 3 to each sledge carriage. Thills, one fourth of the number in use, and one eighth of the shafts. Transoms, one twentieth. Flasks, one sixth. Upright pieces of jacks, one sixth of their number.

Truck wheels, one sixth of the number of carriages. Nails, half a pound per gun-carriage. Friction bands, 3 to 2 carriages. Iron tires for the truck wheels, half the number of gun-carriages. Iron straps for the chevrette, 1 to 2 carriages.

STORES FOR THE GRAND PARK.

We shall mention the articles with which the park should be provided, without giving the quantity of them; because that depends upon the quality of the equipage, the divisions of the army, and the nature of roads, on the resources of the country, and its distance from the frontier. It is to be observed, that the stores for a large army need not be three times as great as for one that is only a third of the force, for the consumption is not equal upon all points at the same time.

For *the Equipment and Implements of Pieces of Artillery;*
the Contents of their Caissons, and the Assortment carried upon them;
*the Articles carried in the Store Waggons;**
do. *Forges;* and
the Load of the Park Caissons; see the remainder of this article.

For *the Names of the Spare Pieces of Wood and Iron belonging to the Gun and other Carriages,* see the Nomenclature and Construction.

Articles that compose the supply of stores.

Infantry and dragoon muskets.
Carabines for cavalry.
Pistols.
Infantry, artillery, and cavalry sabres.
Spare pieces for repairing small arms; the number of these depends upon the care the troops take of their arms; (see *Stores of Fortresses,* vol. 2d, p. 272.)

Infantry cartridges, } See what has been said in speaking of the great park.
Fixed cartridges for cannon, }

* The waggons of the park are often loaded only with spare wooden and iron pieces, and park stores; and have no box to carry the spare iron, like those that accompany the batteries.

Musket flints, (one flint to each half pound of powder, or 10 cartridges, but one to every 20 may suffice.)

Articles necessary in the preparation of ammunition, (see the chapter on that head, vol. 2. pp. 288 to 297.)

Prepared fireworks, (quick match, port fires, rockets, fire-stone.)

Materials for fireworks, (see Military Fireworks, vol. 2. p. 302.)

Slow match for the supply of the caissons.

Tow, 25 pounds for every caisson to be packed.

Moulds to run shot.

Petards.

Wheelbarrows, or wheels and bolts to build them, when wanted.

Hoops for powder barrels.

Hand-barrows for carrying kegs of powder.

Cordage, (gin-tackles, manœuvring prolonges, double prolonges, gun-traces, manœuvring traces, peasants' traces, small ropes.)

Gins, with their equipment.

Jacks and their stands.

Capstans and windlasses.

Screws.

Steelyards.

Eprouvettes.

Spare hausses, and gunner's quadrants.

Instruments to prove and examine cannon.

Machine to bush vents.

Grind stones.

Pioneers and edged tools.

Pit saws.

Saws.

Fuse drawers.

Tarpaulins.

Sheet iron.

Grease for carriages, (12 pounds to 100 carriages for every day of march.)

Spare locks for the caissons.

Brass wire.

Lanthorns and dark lanthorns.

Office furniture, (registers, pens, ink, &c.)

Mathematical instruments, (circumferentors, graphometers, drawing boards, cases of instruments.)

STORES CARRIED BY THE CARRIAGES OF THE EQUIPAGE.

EQUIPMENT AND IMPLEMENTS OF THE PIECES.

Ammunition box,	1 per gun-carriage.
Spunges and rammers,	3 do. or 2.
Handspikes,	4 for a 12 pounder, 3 for other calibers.
Buckets,	1 per gun-carriage.
Worms,	1 to two pieces.
Linstocks,	1 to each gun-carriage.
Ammunition pouches,	4 per piece.
Tube pouches,	1 do.
Port-fire case,	1 do.
Priming wires, (one formed into a gimblet,)	3 do.
Port-fire stocks,	2 do.
Thumbstalls,	2 do.
Gunner's quadrant, when the piece has no hausse,	1 do.

CONTENTS OF THE CAISSONS AND LIMBER BOXES.

Rounds of ammunition for guns and howitzers to be fired by a battery of 6 pieces.	1000, (in round numbers,*) $\frac{1}{4}$ to $\frac{1}{3}$ of which is case shot cartridge for the guns, and $\frac{1}{10}$ for the howitzers.
Tubes,	One third more than the number of rounds.
Portfires,	One to every 6 rounds.
Slow match,†	Eighty feet to each caisson, 6 to each ammunition box.

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* From 150 to 180 rounds are reckoned to each piece, which is called a single set of stores. For the six pounder, one third of the ammunition must be case shot of the large size, because they are often fired at short distances; but for 12 pounders only one quarter is allowed.

† A pound of match ought to last 60 hours; 26 feet of it weighs one pound.

Bricoles, (in one of the caissons,)	Enough for one or two pieces per battery, in case of need.	
Ammunition pouches,	3 to each caisson.	These articles in the caissons being supernumerary, a less number of them need be laid in if each piece is fully equipped for service.
Tube cases,	1 to do.	
Port-fire cases,	2 to do.	
Priming wires, ($\frac{1}{3}$ with gimblet ends,)	3 to do.	
Thumbstalls,	2 do.	
Port-fire stocks,	2 do.	
Bombardeer's sleeves,	2 do.	
Spatulæ to pack the tow,	2 do.	

Articles carried on the Caissons.

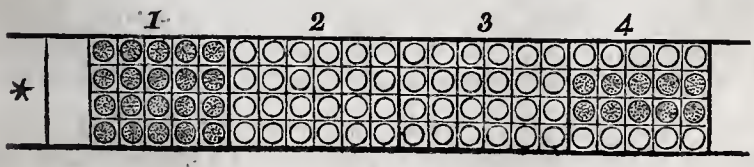
Spare axle trees,	One of each sort to a battery; the lightest is carried on the side of a caisson, and the other on the store waggon.
Spare wheels,	Each caisson carries one, except that which carries an axle tree; when the large wheels are too heavy to be carried thus, they are carried on the store waggon. The spare gun carriage carries one also.
Swing tree bars, and swing trees, Poles, Perches,	Each caisson carries an article of some one of these three kinds; one half of the whole number is poles, one third perches, and one sixth swing-tree bars.
Spades,	2 to each caisson.
Pickaxes,	2 do.
Axes,	1 do.

Note. It is useful to have a little box in front of each caisson; one of which per section of pieces, might contain a chisel, a hatchet, a hand saw, 2 or 3 gimblets, a file, a hand vice, 2 linchpins, some bands and their pins, a few screws and nails of different sizes. The others will carry grease, and should for that purpose be lined with tin plates.

Manner of Loading the Caissons.

The inside of the caisson is divided into 4 great divisions, by 4 planks fixed across it;* each division is subdivided into smaller cases, to lodge the cartridges; they contain more or less of these, according to their caliber. In the first divisions, toward the front, there is a transverse partition, that forms a large case, to contain the ammunition pouches, the portfire case, the tube pouch, the priming wires, thumb stalls, portfire stocks, and spatulæ; in the 6 pounder caisson, we give below, there are 20 case shot cartridges in the first division, 24 ball cartridges in the second, and as many in the third; 10 in the fourth, with 10 case shot cartridges. When the woollen bag that contains the powder is not attached to the cases of shot (as in the ammunition of the 12 pounder, for fear the bag might be torn by the weight of the shot when the cartridge was lifted from its place, and also because, if fixed, it would be too high to be placed upright,) the blank cartridges are laid on their sides, above the case shot, and the others are packed in the adjoining divisions.

In the howitzer caisson, as each howitz of the upper row lies resting upon 4 of those below, and as the lower layer is only 3 in width, the upper one does not contain more than half as many as it does; unless the height of the caisson is divided into two stages, on which two equal beds of howitzes may be laid. The third grand division does not contain any howitzes; it is divided into 5 longitudinal sections; in three of these, the bags of powder are laid, the tubes, port-fires, and slow match; in the other two are placed, the priming wires, port-fire stocks, &c. with one funnel, 2 powder measures, (of 1 lb. and $\frac{1}{4}$ lb.) 4 fuse drivers, 2 mallets, &c.; when there is no division-waggon, in whose box the fuse drawer ought



to be carried, the nearest howitz of the upper row is placed in this division, and the fuse drawer laid in the spot it occupied.

Of Packing the Caisson with tow. Tow is put into the bottom of the cases, and the circumference of each cartridge laid in it, it is pressed forcibly down with a spatulæ, taking care not to tear the bag, and to set it perpendicular, so that it may not shake about, nor rub against the partitions; the port-fires, tubes, &c. are laid upon this packing.

The tow must not be laid on the ground, when a caisson is loaded and unloaded, because a little gravel may stick to it, that if introduced into the gun, might be productive of fatal consequences.

The ball, or the case of shot, ought to be always laid lowermost, and the powder bag above it.

LOAD OF THE CAISSON OF FIREWORKS, UTENSILS, AND STORES.

The inside of this caisson is furnished with 4 trays, 2 stirrups, and a hasp to hold different tools; and 9 cases that contain others. These cases are filled in the following way, and placed in the following order.

Case 1st. Contains 5 lanthorns, a tinder-box, 60 candles in small boxes; it is placed upon the bars that cover the nuts of the bolts of the clamp, (*echarpe*,) and rests against the front of the caisson.

Case 2d. Contains 13 calibers, and 5 gauges for wooden shot bottoms, 4 copper models of shot bottoms, stool models, 3 copper models of fuses, 8 boring bits, 2 small handsaws, 10 priming wires, 6 wooden rasps, 3 small gimblets, 2 iron compasses, 10 hammers for fixing shot bottoms, and a pair of tinman's shears; 12 awls to bore tin plates, and 12 chisels to cut them; 1 mandril and 5 chisels to turn shot bottoms; 4 profiles of shot bottoms and stools; this case is placed on the bottom in the interval of the cross bars.

Case 3d. Contains 200 formers for musket cartridges, 2 iron calibers to examine the formers, 6 pieces of musket barrel to gauge the cartridges. It is placed upon case No. 2, resting against No 1.

Case 4th. Contains 24 copper rods to charge the fuses of howitzes and shells; 14 ladles, 6 of which are for loading the fuses of howitzes, 6 for port-fires, and 2 for rockets; 10 wooden rods, to

roll and charge rockets, and 2 wooden spits; 12 wooden mandrils to roll port-fires upon, and 6 funnels to pour in the composition; 2 iron rulers; 2 iron foot-rules. This case is laid upon No. 2, between No. 3, and the transoms of the caisson.

Case 5th. 2 copper calibers to examine the size of the reeds of priming tubes; 8 rat-tail files; 10 needles to bore tubes; 4 boxes to load them; 9 double gauges to caliber grape shot; copper chisels to open powder barrels. This case is placed upon No. 4.

Case 6th. Contains 60 measures for musket cartridges. It is placed upon No. 3, resting against No. 5, and the right side of the caisson.

Case 7th. Contains 6 pen-knives, 2 pair of scissars, 6 paper knives, 4 hones; it is placed on No. 3, resting against Nos. 5 and 6.

Case 8th. Contains 2 scale beams. It is placed on No. 3, between Nos. 1. 6, 7 9.

Case 9th. Contains several 4 lb. weights. It is placed on No. 3, between Nos. 5. 7. 8, and the left side of the caisson.

The remaining articles are not packed in cases, but are placed in the following order.

10th. 4 tin plate patterns, to cut the woollen for cartridges, placed between the end of the caisson and case No. 1.

11th. A small table to mix firework compositions, laid flat upon the bottom of the caisson.

12th. A machine to prepare the wood for shot bottoms, in the bottom of the caisson resting against the table.

13th. An artificers plane to roll cartridges, rocket cases, &c. it serves as a model for another that cannot be packed in the caisson: placed upon the bottom of the caisson against the barrel, No. 15.

14th. Twenty formers for gun cartridges, placed against the barrel.

15th. An oaken barrel with a cover, and only one head, containing 4 sieves, two of which are of silk, and two of hair, and two leather bags to bruise gunpowder and charcoal in. It lies on its side and touches the front of the caisson.

16th. A mortar to pound sulphur, placed in the left angle at the back of the caisson.

17th. Two copper kettles placed one within the other; they lie

upon the first tray in the right angle of the back of the caisson, their feet enclosing the tray.

18th. Two fuse drawers, one within the other, their vices and their rings, held together by a small hammer, placed on the 3d tray.

19th. A paste pot, or two pans, one within the other, containing also the scales of the small balance; they are placed on a moveable tray in the left angle of the front of the table.

20th. A mallet to beat gunpowder, placed in the right angle of the table.

21st. Shot gauges of all calibers tied together, two small and two large of each caliber, laid upon the table between the mallet and the pans.

22d. Two kegs, with leather covers that draw, to hold grain or meal gunpowder; they contain four brushes to sweep the artificers tables, 12 paste brushes and 4 funnels, and are placed upon the table.

23d. The scales of the large balance, they lie upon the powder kegs, No. 22.

24th. A box containing iron weights, placed upon the table in front of the second keg, where it is held by two hammers.

25th. Five large and 12 small wooden bowls, placed one within the other in the upper pan, No. 19.

26th. A box containing 18 tin measures of different sizes, viz. of 1, 2, 4, and 8 oz. of 1, $1\frac{1}{2}$, $1\frac{3}{4}$, 2, $2\frac{1}{2}$, $2\frac{3}{4}$, 3, and 4 pounds; two measures of $4\frac{1}{4}$, 5, 6, and 8 pounds, placed in the mortar, No. 16.

27th. Two hatchets; one lies between case No. 1, and No. 8, the other between No. 8, and No. 6.

28th. Two bill hooks under case No. 8.

29th. A small bit, with its brace, of the form of a truncated cone; it is laid on the handles of the bill hooks.

30th. Two smith's tongs, on case No. 8.

31st. One rivetting hammer, upon case No. 8. between the two hatchets.

32d. A turning lathe for the shot stools and fuses. The uprights are placed upon the machine No. 12. and the tree between the boxes and the barrel, upon case No. 8.

33d. Eighteen fuse drivers in sizes; they are strewn promiscuously in the interval between the boxes and the barrel; two coopers' drivers are laid with them.

34th. Twenty-four hammers (12 large and 12 small) to drive fuses. They are placed in the interstices of the articles packed behind the middle of the caisson.

35th. A cooper's adze, it is laid upon the gun-cartridge formers.

36th. A copper skimmer for saltpetre, and one of iron to take the clotted pieces out of the paste pot; they lie against the spatulæ.

37th. Two spatulæ to stir saltpetre; they are placed lengthways on the middle of the load, their blades upon the barrel No. 16.

38. Two frames to dry quick match for tubes and other fireworks; they are held by the hasp and stirrup in the corner of the cover of the caisson.

39th. A mould for musket bullets, placed in the left angle in the rear of the caisson.

As the articles are placed, the interstices are filled with tow. (*Gassendi.*)

LOAD OF THE EDGED TOOL CAISSON.

A park caisson, loaded with the weight of 1,500 pounds of edged tools, carries 164 axes, and 336 bill hooks.

The axes are held by means of two ropes, tied to hooks placed at different heights upon the sides of the caisson. They are placed in two rows, their handles interlacing. A first partition of axes is formed in the same way, that contains 82, and then a second of the same number.

The bill hooks are held in their place by traverses that rest upon notches cut into uprights fixed against the sides of the caisson. There are 1º traverses, under each of which are placed 28 bill hooks, their blades flat upon one another, (the edges facing each other by pairs,) and overlapping the opposite ones of each layer. The traverses rest upon the middle of the bill hooks. Two hundred axes and 400 bill hooks might be held by the same number of traverses, but then the bill hooks would shake about as soon as any were removed, which would destroy the tools. It would also be too heavy a load.

LOAD OF A STORE WAGGON.

1 spare axletree for a gun-carriage, if it is not carried by the caisson.
1 spare large wheel for a waggon or gun-carriage.
1 swing tree and bars.
2 braces.
4 fellies, or one sixth of the number of carriages.
8 spokes, or one third of do.
1 jack and its lever.
Pioneers tools, 20 or 30, and a few axes.
1 barrel of grease, (every 6 days it takes a pound for 4 iron axletrees, and 3 lbs. for the same number of wooden ones.)

Contents of the Box.

This waggon ought to carry a box on its front containing the tools of the artillery workmen of the battery, particularly those of the workmen in wood, such as, carpenters' chisels, a wheelwright's sledge, an adze, axes, a hand-saw, an auger, gimblets, gouges, &c. Some smith's tools, such as files, shears, smith's chisel, rivetting hammer, sledge, screw driver, &c.; together with the following spare articles:

6 forked straps, to splice braces, poles, perches, &c.
1 axletree bolt of each size.
50 rose nails of different sizes.
1 pintle bolt of each sort.
2 double keys of each number per caliber.
1 capsquare key, and its chain, to two pieces.
600 nails of different sizes.
~~200~~ tire nails and tinned nails.
2 box clamps of each size.
4 linch pins, for axletrees and wheel bearers to each section of pieces.
4 nuts of each size.
1 washer with a draught hook to each section of pieces.
1 swing tree band and hook.
1 spare hausse, or a gunner's quadrant.

1 swing tree plate per section of pieces.
Double bands for repairing fellies and their pins, (these must be bent in the fire,) 1 to 3 carriages.
do. more pliable, do.
Single fellie bands, do.
Spoke bands, (3 of which will answer to repair poles,) 1 to each carriage.
1 capsquare and chain of each caliber.
3 washers.
1 fuse drawer for howitzes.
1 prolonge to 6 pieces.
4 lashing ropes for mechanical manœuvres.
1 bundle of 24 yards of cord, from $\frac{1}{3}$ to $\frac{1}{4}$ of an inch in diameter.
3 locking ropes, (1 for a gun-carriage, 1 for a caisson, 1 for a waggon.)
4 peasant traces.
1 bundle of 12 yards of slow match.
1 tinder-box and its contents.
1 tin lanthorn and a box of candles.
4 flambeaux, $2\frac{1}{2}$ feet long, in case of their being needed at night.

Note. The same assortment is put into the box that is carried in front of two or three waggons of the bridge equipage, with the exception of the capsquares, the forked washers, the hausse, the fuse drawer, prolonge, &c.

ARTICLES CARRIED WITH THE FORGE.

An anvil and its block, carried on the hearth; a bucket carried behind.

Sea coals, in case charcoal cannot be had. (50 lbs.)

In the box behind it.

A complete set of blacksmith's tools; and also spare iron pieces of the same description as are carried by the store-waggon; a bar of iron about 32 inches long, for every species of tire, and one for each sort of bolts.

The box in front

Ought to contain a complete set of whitesmith's tools ; and some spare pieces besides, such as capsquare keys and chains, nails, tinned nails, nuts, and 10 lbs. of steel, with a jug for oil.

Note. The stores of the forge of a bridge equipage are the same, merely substituting for the above spare pieces, those we have described as carried in the box of its store-waggon.

The tools for a portable mountain forge, are nearly the same ; the spare pieces are such as are required by the mountain carriage.

OF EMBARKING ARTILLERY.

An exact inventory must be taken of the articles to be embarked, together with their weight ; whether they are only a few pieces with their implements, equipment, and ammunition, or a complete artillery equipage. The tonnage of the vessels, over and above their ballast, ought to be one third more than the whole weight to be embarked, in consequence of the great bulk of the vehicles ; if there were nothing to embark but cannon and projectiles, the tonnage of the vessels ought to be equal to the weight to be carried.*

If the embarkation is for a temporary purpose only, place articles belonging to the same calibers together ; but for a long expedition, put the pieces, with the implements, equipments, and ammunition belonging to them, one by one into the vessel, along with the carriages necessary to transport the ammunition, &c. either in whole or part ; in this way no confusion will arise when the disembarkation takes place. If they are battering pieces, embark with them the tools for making platforms, the powder, the pro-

* The burthen of vessels is calculated in tons, the ton is estimated at 2,240 pounds. All sea captains have usually a register that shows the tonnage of their vessels : if they have not, it may be calculated by the following method : multiply the three dimensions of the vessel in feet into each other, and divide the product by 94, the quotient is the number of tons.

jectiles, the loaded fuses, the baskets and plank bottoms for stone mortars, the cartridges, the gin and its equipment, the slow match, and every article necessary to accompany each piece. The different sorts of cannon will be mingled in each ship, according to the order in which they will be probably wanted, as calculated from the knowledge of the plan and object of the expedition.

Thus the artillery attached to the troops must be embarked by entire batteries; the carriages of the magazine park by subdivisions containing a complete assortment of every article. Siege artillery is also embarked by subdivisions completely equipped: if, for instance, there are one hundred 24 pounders, 24 howitzers, 36 mortars and stone mortars; and if 4 transports are provided to carry the whole equipage; twenty-five 24 pounders, 6 howitzers, and 9 mortars and stone mortars, must be embarked in each, with their carriages, platforms, ammunition, implements, &c.; so that if one of the vessels should be lost, the remainder will suffice to fulfil the object, being each fully equipped.

Put them on board in the following order:

The projectiles, (shells, and empty howitzers.)

The cannon.

The platforms.

The gun-carriages separated from their wheels.

Their limbers.

Gunpowder and charcoal in barrels.

Boxes of fireworks, fuses, paper cartridges.

The implements and equipments, boxes containing the pieces of iron that are taken off the carriages when they are dismounted.

Machines to raise weights, and their equipments.

Pioneers tools, spare wooden pieces.

Baskets and wooden bottoms for stone mortars.

Gabions, saucissons, sand bags, (if they must be transported,) chevaux de frise, and the other park stores in boxes, kegs, barrels, &c.*

In general, heavy articles are put below, while every thing that is light, easy to take apart, and likely to be wanted first, is placed uppermost.

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* If forges are to be established, or wheelwrights' shops, where no resources will probably be found; seacoal, bricks, lime, wood, &c. must be carried along.

It is, however, to be observed, that if the disembarkation is to take place in presence or within reach of an enemy, the stowage must be modified in relation to the circumstances that are likely to occur; the field pieces, or at least a part of them, must be so arranged that they, with their implements, ammunition, &c. may be first disembarked, and with as much ease as possible; in like manner, the pioneers' tools, so that intrenchments may be instantly made if they are wanted, or the roads smoothed so as to permit a march in advance, or to a protecting position; and chevaux de frise to form a defence against cavalry.

The several carriages must be taken to pieces to facilitate the stowage; but their parts must be first numbered; each gun and its carriage with the same number; the other carriages with numbers different from it; and each limber or frame for the front of a sledge carriage with the same number as its respective carriage.*

If the several homologous parts of each sort of carriage are not exactly uniform, the different pieces belonging to the same carriage must be marked with its number.

If gun-carriages of different calibers are embarked in the same vessel, pack the iron pieces, such as linchpins, washers, capsquares, and screw drivers fitted to the screws that are to be replaced, in cases; mark upon each case the word *iron*, and the number of the carriage.

The several small implements, such as priming wires, port-fire stocks, gunners' quadrants, shell hooks, &c. and the small equipments, such as ammunition and tube pouches, port-fire cases, cartridge cases, and locking ropes, are packed in cases; the articles for each caliber by themselves if it is a short passage, but if for a long expedition, the implements and equipments of each gun are marked by themselves. Mark on each case the word *implements*, and the number of the gun-carriage to which they belong.

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* Caissons must not be heaped promiscuously together in the vessel, nor must any thing weighty be laid upon them. If their hind axles are not taken off, place the caissons side by side; the projecting parts of the body of the caisson touching each other; then place in each interval a caisson whose front lies against the coupled axle trees of the two first, and so on.

The spindle that carries the spare wheel must, if possible, be left on; if it is taken off, its band should be removed, because it may be either broken or bent in the stowage, and thus prevented from carrying the spare wheel.

While the stowage is going on, it ought to be examined whether the captain makes the best use of the burthen of his vessel.

Each ship-captain ought to have a detailed inventory signed by the storekeeper, and give a copy, or bill of lading, signed by himself, for he is responsible for the several articles. The freight must not be paid him, until the storekeeper to whom the cargo is to be delivered, gives him a receipt.

The convoy must be escorted, if in time of war.

"In disembarking, the order of embarkation must be inverted; put together the carriages to be employed in transportation as soon as possible. Unite the articles, sort by sort, far enough from the bank to prevent confusion.

"If the ammunition is not carried forward at once, but is formed into a sort of park, do not confound the calibers, but separate the different equipments of each.

"If the expedition is to return, and some of the articles are left in the vessels, they must be marked, and a distinct note of them handed to the captain, in order to avoid disputes and altercations, and facilitate ulterior arrangements.

CORDAGE USED BY THE ARTILLERY.

FOR BRIDGES OF BOATS.

Cinquenelle, is 60 fathoms in length, $2\frac{1}{12}$th inches in diameter, for permanent bridges; for those of light boats, it is only half the thickness. It is placed across the river, and the two ends are fixed to windlasses; each boat is moored to it by a rope. There is a loop at each end, a foot and a half in length. It was formerly much used, but is nearly abandoned at the present day. (The large sort weighs 352 pounds, and the small, 130 pounds.)

Hawser, 60 fathoms long, and an inch in diameter: it is used to moor the boats to their anchors, and weighs 120 pounds.

Lashing Rope, 9 feet in length, and half an inch in diameter: it is used to lash the cinquenelle to the boats, and for other purposes of that sort.

Mooring Rope, 15 yards long, 1 inch in diameter: it is used to render the construction of bridges more firm; shrouds are also formed with it to support the mast when the boat is towed: it is sometimes called, from its use, a traverse, or crossing rope.

Shoulder Strap, to tow boats, or haul great burthens by the

strength of men. They are made of a band of plaited rope, 2 feet long, and two inches wide, and two cords, $5\frac{1}{2}$ feet long, and $2\frac{1}{2}$ lines in diameter.

Great Tow Line, 80 fathoms long, and $\frac{2}{3}$ds of an inch in diameter, is used when boats are towed by horses ; (it weighs about 80 lbs.)

Small Tow Line, 80 fathoms long and $\frac{1}{2}$ an inch in diameter, is used to tow boats by men.

FOR THE GIN, AND OTHER PURPOSES.

Combleau is the French name for a rope 26 yards long, and $1\frac{1}{4}$ inches in diameter, that is used in the mechanical manœuvres.

Gin Tackle. 36 yards long, $1\frac{7}{12}$th of an inch in diameter, is used in the manœuvres of the gin ; (it weighs 120 pounds.)

Double Prolonge, 24 yards long, and $1\frac{1}{12}$th inch in diameter : is used to equip the gin with shrouds, or stays ; in the manœuvres of the capstan and windlass, &c.

Single Prolonge, 12 yards long, and 1 inch in diameter ; is used in the manœuvres of Field Artillery, and in all sorts of manœuvres of strength ; (it weighs 9 pounds.)

Gun Trace, 4 yards long, when extended, and $1\frac{1}{6}$th inch in diameter ; when the loop is formed at one end, its length is reduced to 8 feet ; it serves to fix the draught horses to all sorts of heavy carriages, and to fasten guns upon their waggons.

Manœuvring Trace, 3 yards long, including the loop, $\frac{1}{2}$ an inch n diameter : is used, in the manœuvres of the gin when a piece of cannon is raised by the dolphins ; and to fix the pulley to the top of the gin. When it is used for lashing, in mechanical manœuvres ; there is a loop at one end, four inches in length.

Peasant's Trace, 4 yards long, $\frac{2}{3}$ds of an inch in diameter ; they are made like gun traces, and are used in the draught of light carriages, and to tie small weights.

Twine, is $\frac{1}{4}$ of an inch in diameter, and is usually tied up in coils of 24 yards.

END OF THE FIRST VOLUME.

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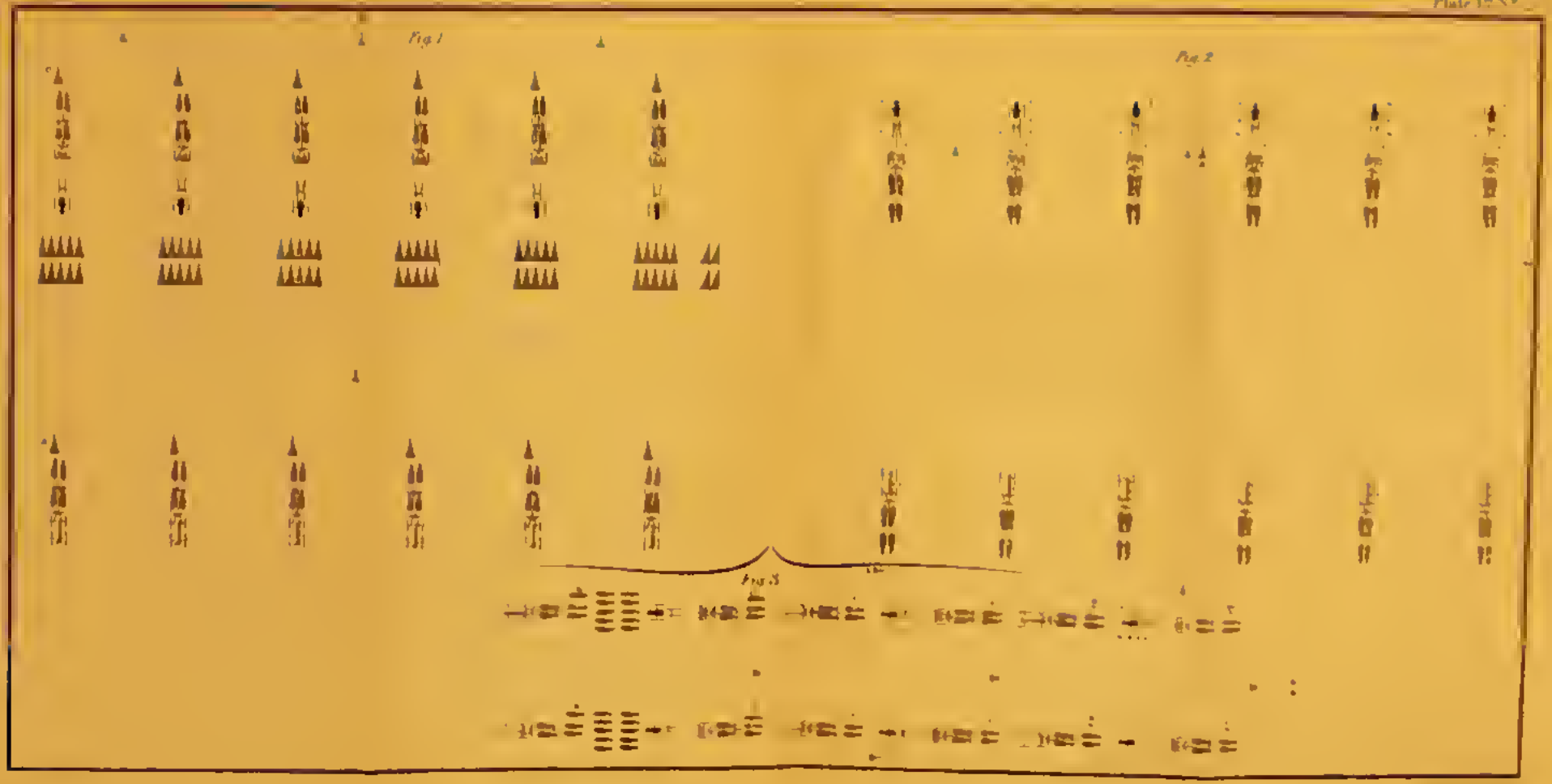
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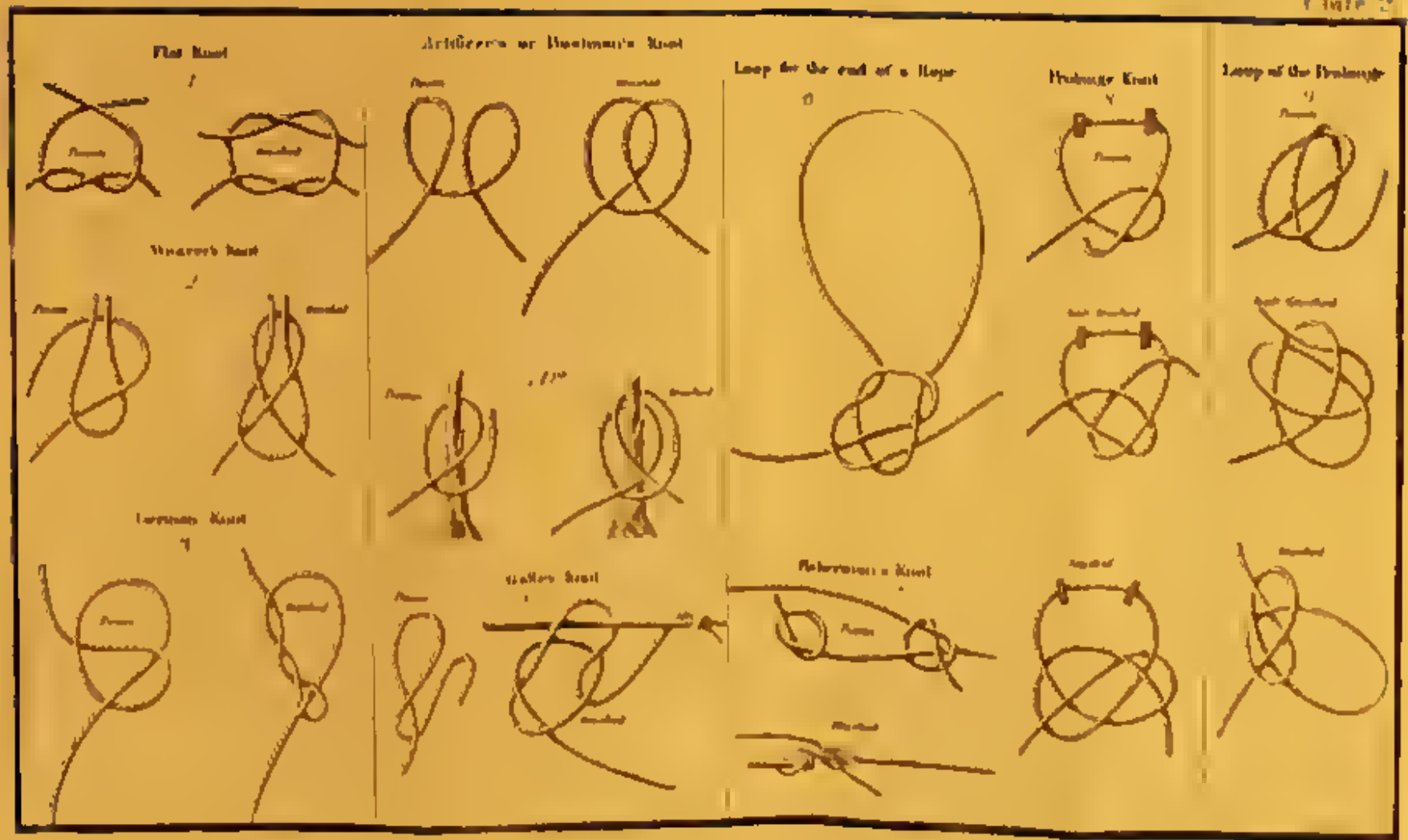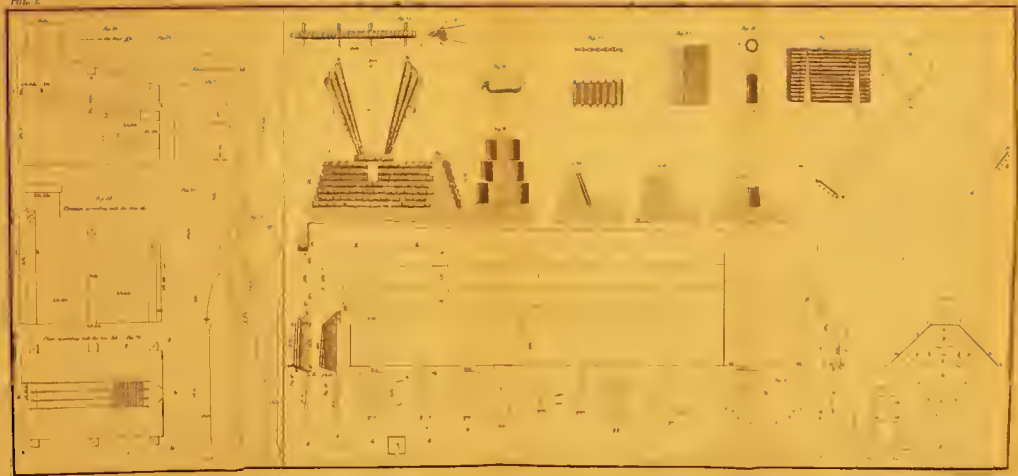
Flat Knot
Artificer's or Bushman's Knot
Loop for the end of a Rope
Prolonge Knot
Loop of the Prolonge
Weaver's Knot
German Knot
Galley Knot
Seberman's Knot